

# City of Millbrae

## Greenhouse Gas Emissions Report

**2005 Community Emissions Inventory  
&  
2004-2005 Municipal Operations Emissions Inventory**



December 2008

## Credits and Acknowledgements

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# Table of Contents

<b>Executive Summary .....</b>	<b>4</b>
1 <b>Introduction.....</b>	<b>6</b>
Climate Change Background .....	6
The Cities for Climate Protection Campaign.....	7
Sustainability and Climate Change Mitigation Activities in Millbrae.....	7
2. <b>Greenhouse Gas Emissions Inventory .....</b>	<b>10</b>
Methods.....	10
CACP Software.....	10
Creating the Inventory .....	11
Local Government Operations Protocol .....	11
3 <b>Community Emissions Inventory .....</b>	<b>13</b>
<i>Emissions by Scope .....</i>	<i>16</i>
<i>Per Capita Emissions.....</i>	<i>17</i>
<i>Commercial, District, and Direct Access Sectors.....</i>	<i>17</i>
<i>Transportation Sector .....</i>	<i>17</i>
<i>Waste.....</i>	<i>18</i>
<i>Sources of Error and Omissions .....</i>	<i>20</i>
<i>Criteria Air Pollutants .....</i>	<i>20</i>
Community Emissions Forecast .....	21
4 <b>Municipal Operations Emissions Inventory.....</b>	<b>22</b>
<i>Municipal Facilities .....</i>	<i>25</i>
<i>Street Lights .....</i>	<i>26</i>
<i>Waste .....</i>	<i>26</i>
<i>Wastewater and Water .....</i>	<i>27</i>
<i>Vehicle Fleet .....</i>	<i>27</i>
<i>Criteria Air Pollutants .....</i>	<i>28</i>
Conclusion .....	28
APPENDIX A <b>Detailed Community Inventory Notes .....</b>	<b>29</b>
APPENDIX B <b>Detailed Government Inventory Notes.....</b>	<b>35</b>
APPENDIX C <b>Emission Factor Sets .....</b>	<b>41</b>
APPENDIX D <b>References .....</b>	<b>44</b>
APPENDIX E <b>Chronological List of the City's Climate Protection Programs.....</b>	<b>45</b>

## Executive Summary

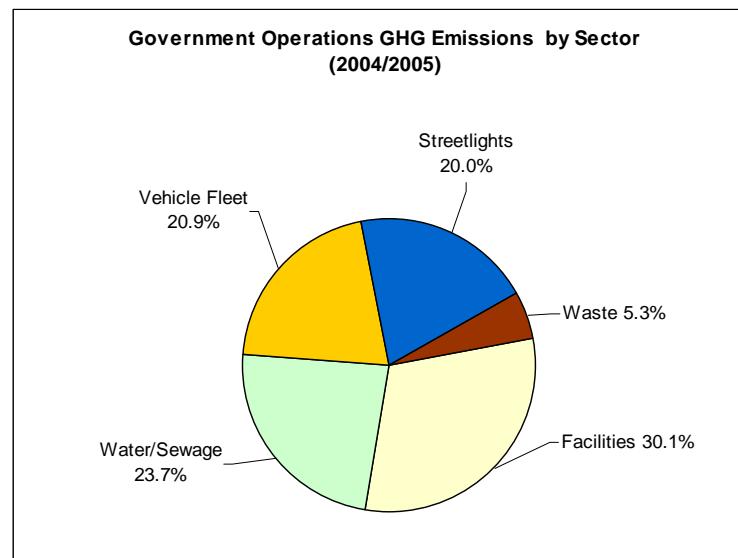
In June 2007 the City of Millbrae adopted the U.S. Mayors Climate Protection Agreement and passed a resolution to participate in ICLEI's membership, pledge and Cities for Climate Protection Programs committing the City to taking action for climate protection, thus recognizing the profound effect that greenhouse gases emitted by human activity are having on the Earth's climate. With the assistance of ICLEI – Local Governments for Sustainability (ICLEI), the City has begun its efforts to identify and reduce greenhouse gas emissions. Through the ICLEI network and resources, Millbrae is also learning about the various opportunities to reduce these emissions, both within its municipal operations and by inspiring change throughout the community.

This document represents the successful completion of the first milestone in ICLEI's Five Milestone process: conducting an inventory of greenhouse gas emissions. Presented here are estimates of greenhouse gas emissions resulting from the City of Millbrae's internal government operations for fiscal year 2004-2005, as well as emissions produced by the community as a whole in the year 2005. Results are reported in metric tons of carbon dioxide equivalent (CO<sub>2</sub>e), a measure that describes how much warming a given type and amount of a greenhouse gas may cause, using the functionally equivalent amount of carbon dioxide (CO<sub>2</sub>) as the reference. These data will provide a baseline against which Millbrae will be able to compare future performance, enabling the City to demonstrate progress in reducing emissions.

### Municipal Operations Inventory

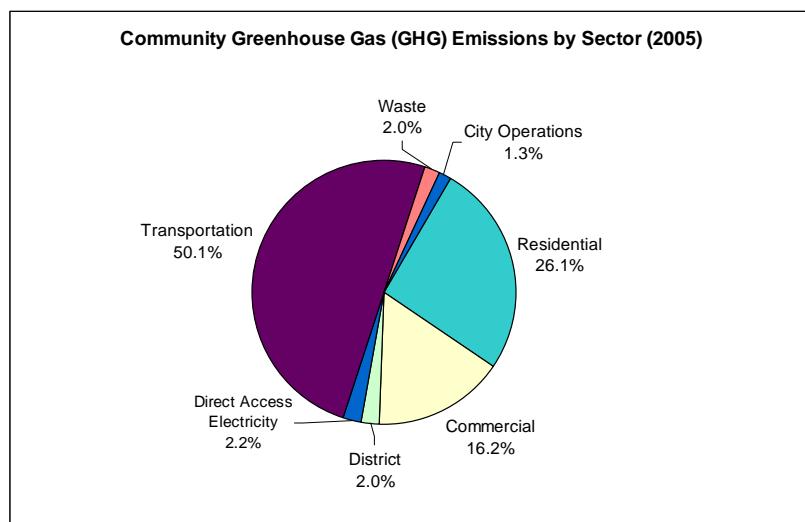
The inventory analysis determined that in the base fiscal year 2004-2005, total government emissions in the City of Millbrae amounted to 1,645 metric tons of carbon dioxide equivalent (CO<sub>2</sub>e). This corresponds to the annual emissions of 1,105 automobiles or the electricity use of 799 homes.<sup>1</sup>

Electricity and natural gas use in the City's facilities resulted in 30.1% of the total greenhouse gas emissions. The vehicle fleet (20.9%), electricity used for streetlights and traffic signals (20.0%), and electricity and natural gas used to treat and pump wastewater and water (23.7%) were responsible for approximately equal shares of the total emissions. Waste (5.3%) made up the smallest share of emissions that were included in this inventory for government operations.



<sup>1</sup> Source: <http://epa.gov/cleanenergy/energy-resources/calculator.html>

During the 2004-2005 fiscal year, the Millbrae municipal government spent approximately \$697,797 on electricity, natural gas, and fuel for its buildings, streetlights, vehicles, and waste disposal. Beyond reducing harmful greenhouse gases, any future reductions in municipal energy use have the potential to reduce this expense, enabling Millbrae to reallocate funds toward other municipal services. Municipal emissions in Millbrae constitute 1.3% of the community's total greenhouse emissions. This is not unusual; local government emissions typically account for around 2% of community levels.



### Community Inventory

In the base year 2005, the community of Millbrae emitted approximately 123,999 metric tons of CO<sub>2</sub>e. The transportation (50.1%), residential (26.1%), and commercial (16.2%) sectors were the largest sources of greenhouse gas emissions. The majority of emissions in Millbrae come from transportation, including private cars, commercial vehicles, the City fleet, and school buses.

The City's greenhouse gas emissions can be significantly reduced through the implementation of cost-effective measures at the municipal level and a combination of voluntary action by citizens and businesses and financial and regulatory "carrots and sticks" created through local policy at the community level. This report is the first step toward evaluating potential reductions, by detailing major emissions sources within both governmental operations and for the community as a whole.

## 1. Introduction

On June 12, 2007, the Millbrae City Council adopted the U.S. Mayors Climate Protection Agreement and passed a resolution to participate in ICLEI's membership, pledge and Cities for Climate Protection Programs, committing the City to taking action for climate protection. Through this resolution, the City recognized the "profound effect" that greenhouse gases emitted by human activity are having on the Earth's climate, as well as the City's opportunity to reduce these emissions, both through its municipal operations and by inspiring change throughout the community. Through energy efficiency in its facilities and vehicle fleet, alternative clean energy sources, waste reduction efforts, land use and transit planning, and other activities, the City of Millbrae can achieve multiple benefits, including saving energy and money, reducing emissions, and preserving the quality of life for the community. With the assistance of ICLEI – Local Governments for Sustainability, the City has begun its efforts to identify and reduce greenhouse gas emissions.

This document represents completion of the first milestone in ICLEI's five milestone process: conducting an inventory of greenhouse gas emissions. Presented here are estimates of greenhouse gas emissions resulting from our community as a whole, as well as those resulting from the City's internal municipal operations. Due to data availability and the desire to conduct a baseline inventory for the same year as other Bay Area cities, community activity data are presented for the year 2005. To be aligned with the City's annual budget cycle, the municipal operations baseline inventory is presented for the fiscal year 2004-2005. This data will provide a baseline against which we will be able to compare future performance, enabling us to demonstrate progress in reducing emissions.

## Climate Change Background

A balance of naturally occurring gases dispersed in the atmosphere determines the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Modern human activity, most notably the burning of fossil fuels for transportation and electricity generation, introduces large amounts of carbon dioxide and other gases into the atmosphere. Collectively, these gases intensify the natural greenhouse effect, causing global average surface temperature to rise, which in turn affects global and local climate patterns.

Overwhelming evidence suggests that human activities are increasing the concentration of greenhouse gases in the atmosphere, causing a rise in global average surface temperature and consequent climate change. In response to the threat of climate change, communities worldwide are voluntarily reducing greenhouse gas emissions. The Kyoto Protocol, an international effort to coordinate mandated reductions, went into effect in February 2005 with 161 countries participating. The United States is one of three industrialized countries that chose not to sign the Protocol.

In the face of federal inaction, many communities in the United States are taking responsibility for addressing climate change at the local level. The City of Millbrae could be impacted by rising sea level, decreased water supply, increased electricity costs, higher average temperatures, as well as other impacts resulting from changes in regional climate patterns. Beyond our community, scientists also expect changing temperatures to result in more frequent and damaging storms accompanied by flooding and land slides, summer water shortages as a result of reduced snow pack, and disruption of ecosystems, habitats and agricultural activities.

## The Cities for Climate Protection Campaign

By adopting a resolution committing the City to locally advancing climate protection, Millbrae has joined an international movement of local governments. More than 800 local governments, including over 450 in the United States, have joined ICLEI's Cities for Climate Protection (CCP) campaign.<sup>2</sup>

The CCP campaign provides a framework for local communities to identify and reduce greenhouse gas emissions, organized along five milestones:

- (1) Conduct an inventory of local greenhouse gas emissions;
- (2) Establish a greenhouse gas emissions reduction target;
- (3) Develop an action plan for achieving the emissions reduction target;
- (4) Implement the action plan; and,
- (5) Monitor and report on progress.

## The ICLEI 5-Milestone Process



This report represents the completion of the first CCP milestone, and provides a foundation for future work to reduce greenhouse gas emissions in Millbrae.

## Sustainability and Climate Change Mitigation Activities in Millbrae

Over the years, the City of Millbrae has implemented a number of programs to reduce greenhouse gas emissions. These programs include: waste reduction, water conservation, using compressed natural gas vehicles for the City's fleet, installing energy efficient equipment in City facilities and LED traffic signals, participating in a Spare the Air Program and notifications, planting 100 trees annually for Arbor Day, providing rebates for installation of photovoltaic systems, using waste grease as an energy source

<sup>2</sup> ICLEI was formerly known as the International Council for Local Environmental Initiatives, but the name has been changed to ICLEI – Local Governments for Sustainability.

at the wastewater treatment plant, and adopting the Sustainable Food Service Ware Ordinance that bans polystyrene (foam & solid) for use by food vendors.

Beginning in 1991, Millbrae created a Water Resources and Conservation Program. In 1994, the City established the Recycling and Waste Prevention Program to comply with California Assembly Bill 939, the Integrated Waste Management Act. At that time, Millbrae became a “Tree City” and began planting 100 trees annually for Arbor Day. Also, in 1994, the City Developed the Millbrae Station Area Specific Plan that included land use policies for developing residential and commercial development near transit.

Over the years, the City of Millbrae has implemented a number of programs to reduce greenhouse gas emissions. These programs include: waste reduction, water conservation, using compressed natural gas vehicles for the City’s fleet, installing energy efficient equipment in City facilities and LED traffic signals, participating in a Spare the Air Program and notifications, planting 100 trees annually for Arbor Day, providing rebates for installation of photovoltaic systems, using waste grease as an energy source at the wastewater treatment plant, and adopting the Sustainable Food Service Ware Ordinance that bans polystyrene foam and solid food service ware and requires the use of recyclable, reusable or biodegradable/compostable food service ware for use by food vendors.

Current community and municipal operations to reduce greenhouse gas emissions include a recycling and waste prevention program that in 2005 achieved a 67% diversion rate and a wastewater treatment plant that runs on brown kitchen waste grease.

Through the Sustainable Millbrae Program (2006), the City continues to explore and implement new systems designed to further enhance quality of life by means of the long-term improvement of the environment, economy, and social well-being in the City. Recent initiatives have included the following:<sup>3</sup>

**2006:**

- Developed the Sustainable Millbrae Program to develop and implement programs for our community to improve the health of our citizens and the environment.
- Began a bio-gas operation to use brown kitchen waste grease to provide energy at the Treatment Plant.
- Achieved a 67% waste reduction and recycling diversion rate (AB 939).

**2007:**

- Adopted two Climate Protection Pledges/Campaigns: US Mayors and ICELI - Cities for Climate Protection.
- Began participating in the Silicon Valley Joint Venture Climate Task Force to implement regional programs.
- Began Climate Protection outreach programs, including setting up a display in City Hall with handouts, publishing an article in the City residential newsletter and airing public service announcements on the local cable station.
- Planted 300 trees on a main thoroughfare, El Camino Real Street.
- Started a Solar Rebate Program.
- Began new outreach on Green Building with targeted brochures.

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<sup>3</sup> See Appendix E for a complete chronological list of the City’s Climate Protection Programs

- Began participating in a Green Business Program to certify businesses. Four businesses were certified.
- Adopted the Sustainable Food Service Ware Ordinance banning polystyrene foam and solid food service ware and requiring the use of recyclable, reusable or biodegradable/compostable food ware for use by food vendors, including restaurants, cafes, grocery stores and City Departments and facilities. This went into effect on January 1, 2008.
- Distributed 2,500 reusable tote shopping bags to date made from recycled plastic bottles to reduce the number of plastic bags used and littered.
- Implemented linen and towel reuse programs at three hotels and motels to conserve water and energy.

### **2008:**

- Developed a greenhouse gas inventory report via a contract with ICLEI. Work began to outline strategies to implement in the short term.
- Signed onto PG&E's ClimateSmart Program to offset greenhouse gas emissions from City operations.
- Signed onto San Francisco Community Power's Energy Alert Day program for City hall (includes the Police Station) and Community Center. Participated in one alert day and reduced energy use by 9% (25 kilowatts) at City Hall.
- Started using 100% post-consumer copy paper at City facilities.
- Conducted a City wide paper reduction campaign and reduced paper purchases from the previous year by 11 cases.
- Placed recycling containers for the public in the downtown area for the collection of cans and bottles and mixed paper.
- Installed water saving devices at City facilities including kitchen and bathroom aerators and showerheads.
- Certified City Hall as a Green Business. Conducted outreach to businesses to participate.
- Switched to integrated pest management for indoor City facilities.
- Started a City employee Commuter Options and Incentives Program. Conducted an employee commute survey to learn of transportation methods to and from work to help in developing a comprehensive program to reduce single car occupancy travel. Conducted outreach to employees on public transportation options and incentives.
- Began participating in the County's new program, CO2 San Mateo County that includes developing an energy and water strategy.

### **Water Resources and Conservation Program**

The Water Resources and Conservation Program provides the following resources to residents, businesses and schools to reduce water consumption. Programs are also in place to reduce City facility water consumption.

- High efficiency toilet and clothes washer rebates
- Newsletters, brochures and flyers on conserving water and water wise and native plant gardening
- Native Plant Landscaping and Irrigation Workshops
- Commercial landscape water audits and reports
- Water conserving device handouts: bathroom and kitchen faucet aerators, showerheads, shower timers, water leak tablets, sprinkler gauges, water-wise garden CD

### **Recycling & Waste Prevention**

The Recycling & Waste Prevention Program provides a variety of programs and resources for residents, businesses, schools and city departments to reduce the amount of waste placed in landfills. AB 939 requires cities and counties to reduce waste by at least 50%. Since 1999, the City has achieved and surpassed the 50% waste reduction requirement goal. For 2006, the last reporting year, the City achieved a 67% diversion rate.

- The City conducts waste prevention and recycling programs for the community to provide opportunities for the many ways to reduce, reuse, recycle and buy recycled products. Another focus is to reduce the amount of household hazardous waste that is used and disposed of in landfills, outreach on proper disposal, and to educate on non-toxic alternatives.

## 2. Greenhouse Gas Emissions Inventory

The first step toward reducing greenhouse gas emissions is to identify baseline levels and sources of emissions in Millbrae, as well as the sectors of community and government operations that are responsible for the bulk of these emissions. This information can later inform the selection of a reduction target and possible reduction measures.

### Methods

ICLEI's Cities for Climate Protection campaign assists local governments to systematically track energy and waste related activities in the community, and to calculate the relative quantities of greenhouse gases produced by each activity and sector. The greenhouse gas inventory protocol involves performing two assessments: a community wide assessment and a separate inventory of municipal facilities and activities. The municipal inventory is a subset of the community inventory.

Once completed, these inventories provide the basis for the creation of an emissions forecast, and allow for the quantification of emissions reductions associated with proposed measures.

### CACP Software

To facilitate community efforts to reduce greenhouse gas emissions, ICLEI developed the Clean Air and Climate Protection (CACP) software package in partnership with the State and Territorial Air Pollution Program Administrators (STAPPA), the Association of Local Air Pollution Control Officials (ALAPCO)<sup>4</sup>, and Torrie Smith and Associates. This software calculates emissions resulting from energy consumption and waste generation. The CACP software calculates emissions using specific factors (or coefficients) according to different activity types. Greenhouse gas emissions are aggregated and reported in terms of equivalent carbon dioxide units, or CO<sub>2</sub>e. Converting all emissions to equivalent carbon dioxide units allows for the consideration of different greenhouse gases in comparable terms. For example, methane is twenty-one times more powerful than carbon dioxide on a per weight basis in its capacity to trap heat, so the CACP software converts one metric ton of methane emissions to 21 metric tons of carbon dioxide equivalents. The CACP software is also capable of reporting input and output data in several formats, including detailed, aggregate, source-based and time-series reports.

<sup>4</sup> Now the National Association of Clean Air Agencies (NACAA)

The emissions coefficients and quantification method employed by the CACP software are consistent with national and international inventory standards established by the Intergovernmental Panel on Climate Change (1996 Revised IPCC Guidelines for the Preparation of National Inventories) and the U.S. Voluntary Greenhouse Gas Reporting Guidelines (EIA form 1605).

The CACP software is used by over 200 U.S. cities and towns to quantify their greenhouse gas emissions. However, it is important to note that calculating emissions from energy use, fuel consumed, and waste disposed with precision is difficult. The model depends upon numerous assumptions, and it is limited by the quality of available data. With this in mind, it is useful to consider specific numbers generated by the model as an approximation of reality, rather than an exact value.

## **Creating the Inventory**

The greenhouse gas emissions inventory consists of two distinct components: one for the Millbrae community as a whole, defined by its geographic borders, and the second for emissions resulting from the City of Millbrae's municipal operations. The municipal inventory is effectively a subset of the community-scale inventory (the two are not mutually exclusive). This allows the municipal government, which has formally committed to reducing emissions, to track its individual facilities and vehicles and to evaluate the effectiveness of its emissions reduction efforts at a more detailed level. At the same time, the community-scale analysis provides a performance baseline against which the City can demonstrate progress being made in the future.

Creating this emissions inventory required the collection of information from a variety of sources, including the Pacific Gas and Electric Company (PG&E), the Metropolitan Transportation Commission, the California Integrated Waste Management Board, CalTrans, and internal City records. Data from the year 2005 were used for the community inventory, with the exception of a subset of the waste data, which came from a California statewide waste characterization study conducted in 2003-2004. Data collected for the municipal inventory were from fiscal year 2004-2005, except data for electricity and natural gas use, which were from calendar year 2005.<sup>5</sup>

## **Local Government Operations Protocol**

Near the end of the completion of this inventory report, ICLEI, the California Air Resources Board (CARB), and the California Climate Action Registry (CCAR) released the Local Government Operations Protocol (LGOP), a document that was designed to provide a standardized set of guidelines to assist local governments in quantifying and reporting GHG emissions associated with their government operations. Because a majority of the data had been collected and the results analyzed prior to the completion of the LGOP, ICLEI was not able to conduct an inventory, or inventory report that is fully compliant with the LGOP. Where time and resources permitted, results were updated and re-calculated in accordance with the methods described in the LGOP.

### **Scopes**

For both the inventory of community activities and government operations, emissions sources are categorized as *Scope 1, Scope 2, or Scope 3 in accordance with the LGOP*. In the two contexts, the definitions of these categories differ slightly.

<sup>5</sup> At the time of data collection, PG&E was unable to provide fiscal year data.

ICLEI categorizes community emissions sources in terms of where they occur in relationship to the geographic boundaries of a place and the timescale of an inventory:

- **Scope 1:** Emissions which occur within the boundaries of a community.
- **Scope 2:** Emissions which occur outside of the community boundaries, but are a direct result of community activities.
- **Scope 3:** Emissions from up-stream processes or lifecycle/lifetime energy embodiment and process emissions.

For government operations, emissions sources are categorized according to where they fall relative to the operational boundaries of the local government:

- **Scope 1:** Direct emissions from sources within a local government's organizational boundaries that the local government owns or controls.
- **Scope 2:** Indirect emissions associated with the consumption of purchased or acquired electricity, steam, heating, and cooling. Scope 2 emissions occur as a result of activities that take place within the organizational boundaries of the reporting entity, but that occur at sources owned or controlled by another entity.
- **Scope 3:** All other indirect emissions not covered in Scope 2, such as emissions from up-stream and downstream activities that occur as a result of activities within the operational boundaries of the local government, emissions resulting from the extraction of and production of purchased materials and fuels, contracted services, and waste disposal.

Scope 1 and Scope 2 sources are those which ICLEI consider essential components of a local greenhouse gas analysis. This determination is based on significance of the category in terms of the total emissions profile of most local governments, applicability of data to policy relevant climate protection solutions available to local governments, and availability of data at the local government scale. When conducting an emissions inventory, all Scope 1 and Scope 2 categories must be included.

Scope 3 emissions sources are those which are generally challenging to gather reliable data for at a local level, and which often can only be calculated using national level models. The major exception to this is the waste sector, which has been included in Scope 3 because of the significant lifecycle emissions component. Emissions from waste disposal should be included for both government operations and community scale inventories. ICLEI encourages local governments to conduct as complete an analysis as is practicable, but distinguishes Scope 3 emissions sources so that local governments can prioritize their efforts and appropriately categorize emissions sources according to where the emissions occur, the relative magnitude of the emissions, and which entity(ies) is(are) responsible for the emissions. Examples of Scope 3 emission sources include tailpipe emissions from rail, sea, and airplanes for the community, employee commute, and outsourced services for government operations.<sup>6</sup> In general, it is acceptable to rely on less specific data sources for estimating Scope 3 emissions.

<sup>6</sup> See Table 1 in Appendix A and Table 2 in Appendix B for a more complete list of secondary emissions sources.

One of the most important reasons for using the Scopes framework for reporting greenhouse gas emissions at the local level is to prevent double counting for major categories such as electricity use and waste disposal. If, for example, all of the cities in a county decided to aggregate their community emission inventories to create a county-level inventory without disaggregating Scopes, the emissions from electricity and waste sectors would be double counted if there were any power plants or active landfills located in the county.

At the community scale and within any local government's own operations there will be emission sources that fall within Scope 1 and Scope 2 that are minimal in magnitude and difficult to accurately measure. At the community level this could include yard equipment, stationary or portable generators, as well as high global warming potential gases produced as a result of electricity transmission or industrial processes. At the local government level, rarely used backup generators and fugitive emissions from a fleet maintenance facility are two examples. For these small, difficult to quantify emission sources the Local Government Operations Protocol specifies that up to five percent of emissions can be reported as *de minimus*, without quantifying their magnitude. At the community scale, a five percent *de minimus* rule of thumb can also be used.

Time and budget constraints meant that most Scope 3 and *de minimus* emissions were not included in the Millbrae emissions inventory with the exception of solid waste generated within Millbrae.

### 3. Community Emissions Inventory

In the base year 2005, the community of Millbrae emitted approximately 123,999 metric tons of CO<sub>2</sub>e. As shown in Table 1, and illustrated in Figure 1 below, the transportation (50.1%), residential (26.1%), and commercial (16.2%) sectors were the largest sources of greenhouse gas emissions. Table 2 breaks down greenhouse gas emissions by energy source. The burning of gasoline (45.5%), natural gas (29.3%), and electricity (18.2%) was responsible for most of the greenhouse gas emissions in Millbrae. The remaining categories, with the exception of diesel, are landfilled materials that emit methane and carbon dioxide.

Figure 1: Community-Wide Greenhouse Gas Emissions

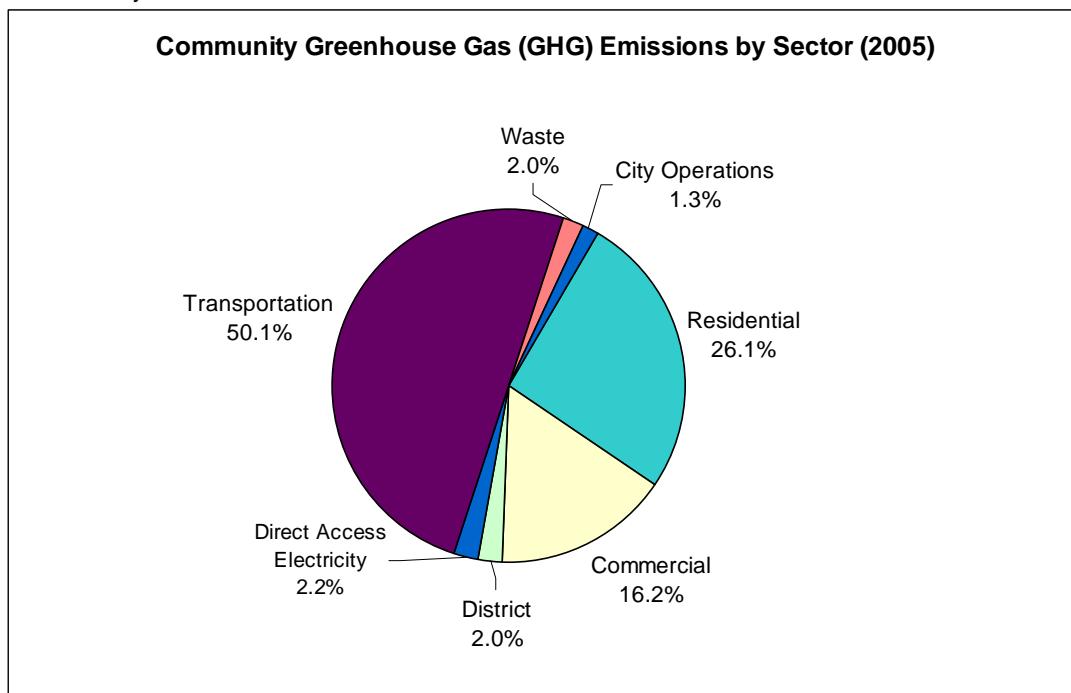


Table 1: Community-Wide Greenhouse Gas Emissions by Sector in 2005

Sector	Greenhouse Gas Emissions (%)	Greenhouse Gas Emissions (metric tons CO <sub>2</sub> e)	Energy Equivalent (MMBtu)
Transportation <sup>7</sup>	50.1%	62,141	850,295
Residential <sup>8</sup> (Electricity and Gas)	26.1%	32,405	570,675
Commercial <sup>9</sup> (Electricity and Gas)	16.2%	20,122	348,845
Waste <sup>10</sup>	2.0%	2,466	0
Direct Access Electricity <sup>(estimate) 11</sup>	2.2%	2,727	28,911
City Government (All Municipal Operations)	1.3%	1,645	23,924
District Government (Electricity and Gas) <sup>12 13</sup>	2.0%	2,493	42,702
<b>Total</b>	<b>100.0%</b>	<b>123,999</b>	<b>1,865,352</b>

Table 2: Community-Wide Greenhouse Gas Emissions by Energy Source, 2005

Energy Source	Greenhouse Gas Emissions (%)	Greenhouse Gas Emissions (metric tons CO <sub>2</sub> e)	Energy Equivalent (MMBtu)
Gasoline	45.5%	56,453	782,793
Natural Gas	29.3%	36,321	679,093
Electricity	18.2%	22,549	331,537
Diesel	4.9%	6,032	71,929
Paper Products	1.1%	1,373	0
Food Waste	0.4%	540	0
Wood / Textiles	0.4%	470	0
Plant Debris	0.1%	170	0
Fugitive CH <sub>4</sub> emissions <sup>14</sup>	0.0%	40	0
Refrigerants	0.0%	28	0
Process N <sub>2</sub> O emissions <sup>15</sup>	0.0%	22	0
<b>TOTAL</b>	<b>100%</b>	<b>123,999</b>	<b>1,865,352</b>

<sup>7</sup> See Table 7 for Transportation Sector breakdown. This number does not include emissions occurring from municipally owned vehicles, which are included in the “City Government” category. Total emissions were calculated for municipal vehicles and then subtracted from the total emissions occurring with Millbrae city limits.

<sup>8</sup> Data Source: Pacific Gas and Electric Company

<sup>9</sup> Data Source: Pacific Gas and Electric Company

<sup>10</sup> Does not include emissions from municipal waste. Municipal waste is included in the “City Government” category.

<sup>11</sup> In 2005, Direct Access customers (those electricity customers that purchase electricity directly from power generation facilities, which is delivered through the transmission lines of public or private utility) accounted for 10.76% of the total electricity usage for all users in San Mateo County. This number was used to estimate Direct Access electricity usage within incorporated Millbrae. See Appendix A for a more complete description of Direct Access.

Source: Andrea Gough, California Energy Commission, (unpublished data). Received November 2007.

<sup>12</sup> Data Source: Pacific Gas and Electric Company

<sup>13</sup> District accounts include any district government account within incorporated Millbrae, such as the Bart Area Rapid Transit (BART), School Districts, Hospital Districts, Water or Sewer Districts, District Fairs, Public Utility Districts, Community Service Districts, Cemetery Districts, Mosquito Abatement Districts and Park Districts.

<sup>14</sup> From the Millbrae Wastewater Treatment Plant

<sup>15</sup> From the Millbrae Wastewater Treatment Plant

### ***Emissions by Scope***

Most of the emissions quantified in this report are from Scope 1 (Figure 2 and Table 4, due to the transportation sector and use of natural gas in the residential and commercial sectors. Table 3 lists the emission types by scope that were measured for each sector.

Table 3: Emissions Type by Scope

<b>Sector</b>	<b>Scope 1</b>	<b>Scope 2</b>	<b>Scope 3</b>
Residential	<i>Natural Gas</i>	<i>Electricity</i>	
Commercial	<i>Natural Gas</i>	<i>Electricity</i>	
District	<i>Natural Gas</i>	<i>Electricity</i>	
Direct Access		<i>Electricity</i>	
Transportation	<i>Gasoline &amp; Diesel</i>		
Waste			<i>Methane Commitment</i>
City Operations	<i>Natural Gas, Gasoline, Diesel, Stationary Air Conditioning Refrigerants, Wastewater Fugitive and Process Emissions</i>	<i>Electricity</i>	<i>Methane Commitment</i>

Figure 2: Emissions Sources by Scope

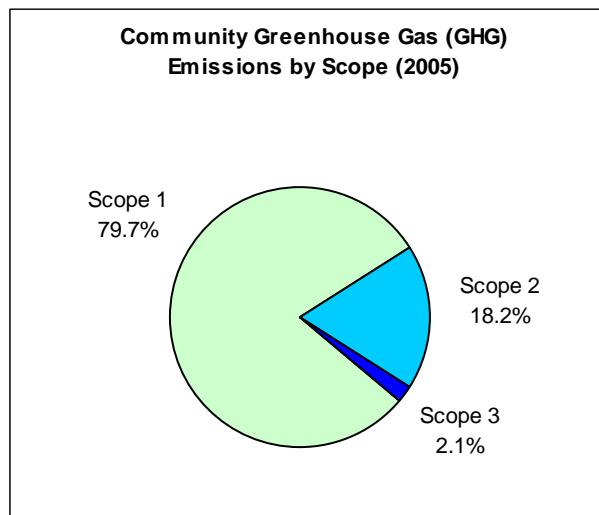


Table 4: Emissions by Scope (Metric Tons CO<sub>2</sub>e)

Sector	Scope 1	Scope 2	Scope 3	TOTAL
Residential	22,138	10,267		32,405
Commercial	12,638	7,484		20,122
District	1,317	1,176		2,493
Direct Access		2,727		2,727
Transportation	62,141			62,141
Waste			2,466	2,466
City Operations	661	896	87	1,644
<b>TOTAL</b>	<b>98,895</b>	<b>22,550</b>	<b>2,553</b>	<b>123,999</b>
<b>Percentage of Total CO<sub>2</sub>e</b>	<b>79.8%</b>	<b>18.2%</b>	<b>2.1%</b>	<b>100%</b>

### ***Per Capita Emissions***

Per capita emissions can be a useful metric for measuring progress in reducing greenhouse gases and for comparing one community's emissions with those from neighboring communities and against regional and national averages. Currently, it is difficult to make meaningful comparisons between cities because of variation in the methods employed and scope of inventories conducted, but in the near future most local governments will be using a universal reporting standard. The Local Government Operations Protocol described in the Methods section is the first step towards realizing this standard.

Dividing the total greenhouse gas emissions by population<sup>16</sup> yields a result of 5.84 metric tons CO<sub>2</sub>e per capita. It is important to understand that this number is not the same as the carbon footprint of the average individual living in Millbrae.<sup>17</sup> It is also important to note that the per capita emissions number for Millbrae is not directly comparable to every per capita number produced by other emissions studies because of differences in emission inventory methods.

### ***Commercial, District, and Direct Access Sectors***

The Commercial and District sectors are comprised of electricity and natural gas usage as reported by PG&E for customers that fall within the two respective rate categories. Commercial users are small to large non-residential and non-industrial accounts. The District category includes any district government account within incorporated Millbrae, such as School Districts, Hospital Districts, and Water or Sewer Districts. The specific district accounts that comprise this category were not provided by PG&E. The Direct Access category refers to electricity users that purchase electricity directly from power producers. PG&E is able to track this usage because the electricity travels on power lines that they own. Because of confidentiality rules, however, in most small to medium sized cities the usage amount cannot be disclosed due to the small number of users.<sup>18</sup> The percentage of emissions from commercial utility customers is typical of small, mostly residential communities, comprising 16.2% of total emissions.

### ***Transportation Sector***

The transportation sector's relative contribution to greenhouse gas emissions is highlighted in Table 5. As with other San Francisco Bay area cities, travel by motorized vehicle constitutes a significant percentage of greenhouse gas emissions. Because El Camino Real (State Highway 82), State Highway 101, and Interstate 280 traverse Millbrae, more than four-fifths of the emissions in the transportation

<sup>16</sup> In 2005, Millbrae's population was approximately 21,200.

<sup>17</sup> Carbon footprint calculations include upstream lifecycle emissions, which were not included in this emissions inventory.

<sup>18</sup> See Appendix A for a more detailed explanation of Direct Access.

sector came from travel on highways. As Millbrae moves forward with its climate protection efforts it should focus its attention on the 15.4% of transportation emissions that occur on local roads. This already low number can be reduced further by making it easier for residents to use alternative modes of transportation, including walking, bicycling, and riding public transportation. The 873 metric tons of CalTrain emissions are from trains traveling within the city limits of Millbrae.

Emissions that resulted from the air travel of Millbrae residents were not included in the transportation sector. With more time and the availability of suitable proxy data, the greenhouse gas emissions from air travel could be estimated. Because there are no airports located within the geographic boundaries of Millbrae and air travel is a form of transportation that the municipal government of Millbrae has little influence or control over, it is reasonable to exclude air travel from this inventory.

Scope 2 emissions from the generation of electricity that powers BART trains were also not included in the inventory. At the time of data collection it was not possible to obtain emission coefficients for the electricity that BART purchases.<sup>19</sup>

Table 5: Transportation Sector Greenhouse Gas Emissions in 2005

Transportation Road Type Emissions Sources 2005	Local Roads	Highways	CalTrain	TOTAL
CO <sub>2</sub> e (metric tons)	9,630	51,981	873	62,484
Percentage of Total CO <sub>2</sub> e	15.4%	83.2%	1.4%	100%
Energy Use (MMBtu)	131,864	711,757	11,101	854,722
Vehicle Miles Traveled	197,724,600	106,466,485	--	126,191,085

### **Waste**

The waste sector's relative contribution to greenhouse gas emissions is highlighted in Table 6, Table 7, and Table 8.

Table 6: Waste Generated in Millbrae, Greenhouse Gas Emissions in 2005

Waste Type	Quantity of Waste Generated (metric tons)	Greenhouse Gas Emissions (metric tons CO <sub>2</sub> e )	Greenhouse Gas Emissions (% CO <sub>2</sub> e )
Solid Waste	13,481	2,461	96.4%
ADC	1,347	92	3.6%
<b>Total</b>	<b>14,828</b>	<b>2,553</b>	<b>100.0%</b>

Table 7: Landfilled Waste Composition

<sup>19</sup> BART is a Direct Access electricity customer. See Appendix A for an explanation of Direct Access electricity.

<b>Landfill Solid Waste Composition:</b>	
Paper Products	20.50%
Food Waste	12%
Plant Debris	9.30%
Wood/Textiles	19.20%
All Other Waste	39%

Emissions from waste generated by Millbrae residents and businesses that was landfilled in 2005 will be responsible for 2,553 metric tons of CO<sub>2</sub>e over the lifetime of the landfill, accounting for 2.0% of the City's total emissions in the base year. The majority of the waste generated in Millbrae in 2005 was sent to Ox Mountain Sanitary landfill in Half Moon Bay.

Emissions from the waste sector in Millbrae were calculated using a version of the EPA Waste Reduction Model (WARM) that is contained within the CACP Software. WARM uses the concept of methane commitment, where all of the future emissions that will occur due to the decomposition of waste in a landfill are accounted for in the base year. WARM calculates the emissions that will occur during the lifetime of waste that is disposed of using a variety of waste disposal technologies, including landfilling, recycling, incineration, composting, and source reduction. These calculations are primarily based on the composition of the waste and the waste disposal technology employed, including methane capture. These emissions are categorized in Scope 3 to distinguish them from emissions that occurred within the city limits of Millbrae.

It is important to note that while waste reduction through recycling does not overtly show up in this inventory, recycling saves a substantial amount of energy by reducing the need for virgin inputs, and by diverting paper products from landfills, which reduces the amount of landfill gas that is produced. The emissions benefits of recycling can be quantified when analyzing recycling as an emissions reduction strategy relative to the base year.

Table 8: Active Landfills that Received Waste Generated in Millbrae

<b>Landfill</b>	<b>Waste Received (Metric Tons)</b>	<b>ADC (Metric Tons)</b>	<b>ADC Material</b>
Altamont	4	291	sludge
Vasco Road	5		
West Contra Costa	1		
Bakersfield	2		
Azusa Land Reclamation	17		
Redwood Sanitary	0		
Ox Mountain Sanitary Landfill	13,025	158	green material
Hillside Class 111 Disposal Site	160		
Pacheco Pass Sanitary	4		
Zanker Material Processing	68		
Newby Island Sanitary Landfill	0		
Zanker Road Class III Landfill	16		
B-J Dropbox Sanitary	20		
Potrero Hills	159	898	C&D; sludge
Covanta Stanislaus, Inc.	0		
<b>Total</b>	<b>13,481</b>	<b>1,347</b>	

### ***Sources of Error and Omissions***

An important part of an emissions inventory is understanding the sources of error and omissions.

- The use of natural gas by Direct Access customers in Millbrae has not been included in this inventory because the data are not collected by PG&E, nor is there a way to easily identify these users. The emissions from Direct Access electricity customers were estimated by assuming that the percentage of Direct Access electricity used in San Mateo County is approximately equivalent to the percentage used in Millbrae, as described above.
- In the transportation sector, emissions from off-road vehicles were not included, including construction equipment, forklifts and other warehouse vehicles, and riding lawnmowers or any other landscaping-related equipment. All of these emissions fall into the category of “de-minimus” emission sources. That is, they comprise less than five percent of the emissions in the total inventory. As described in the transportation sector overview, air travel was also not included.
- The emission factor used for calculating CO<sub>2</sub>e from vehicle miles traveled (VMT) in the transportation sector is a San Mateo County specific number. To the extent that the mix of vehicles on the road and the driving conditions of the average VMT in Millbrae differ from those of the County, the total emissions in the sector could be overestimated or underestimated.
- With the possible exception of the emission factors used for the electricity and natural gas sectors, the science and systems that informs the creation of these factors will improve, resulting in the development of more accurate methods. When conducting future inventories it may be necessary to go back and apply new emission factors to the activity data that was collected for this report in order to ensure inter-year comparability.

### ***Criteria Air Pollutants***

The use of electricity and other fuels in local buildings and vehicles is also responsible for the release of criteria air pollutants, including nitrogen oxides (NO<sub>x</sub>), sulfur oxides (SO<sub>x</sub>), carbon monoxide (CO), volatile organic compounds (VOCs), and particulate matter of ten micron diameter (PM<sub>10</sub>). The transportation sector is responsible for the majority of NO<sub>x</sub>, CO, and VOC emissions, while energy used in buildings is primarily responsible for emissions of SO<sub>x</sub> and PM<sub>10</sub>. It is important to note that only the transportation sector emissions and emissions from the use of natural gas are occurring within the geographic boundaries of Millbrae and affecting local air quality. Criteria air pollutant emissions for all sectors should be considered estimates, rather than precise figures. Emission factors for Direct Access electricity use and the Transportation sector are based on national average sets.

Table 9: Criteria Air Pollutant Emissions in 2005

Sector	NO <sub>x</sub> (metric tons)	SO <sub>x</sub> (metric tons)	CO (metric tons)	VOCs (metric tons)	PM <sub>10</sub> (metric tons)
<b>Residential</b>	51	14	20	3	11
<b>Commercial</b> <sup>20</sup>	19	12	11	1	10
<b>Direct Access</b> <sup>21</sup>	3	2	2	0	2
<b>Transportation</b>	245	16	2,056	214	6
<b>Total</b>	<b>319</b>	<b>43</b>	<b>2,089</b>	<b>218</b>	<b>29</b>

<sup>20</sup> Includes City, and District Government Facilities.

<sup>21</sup> See Appendix A for a more detailed explanation of how Direct Access electricity usage and emissions were estimated.

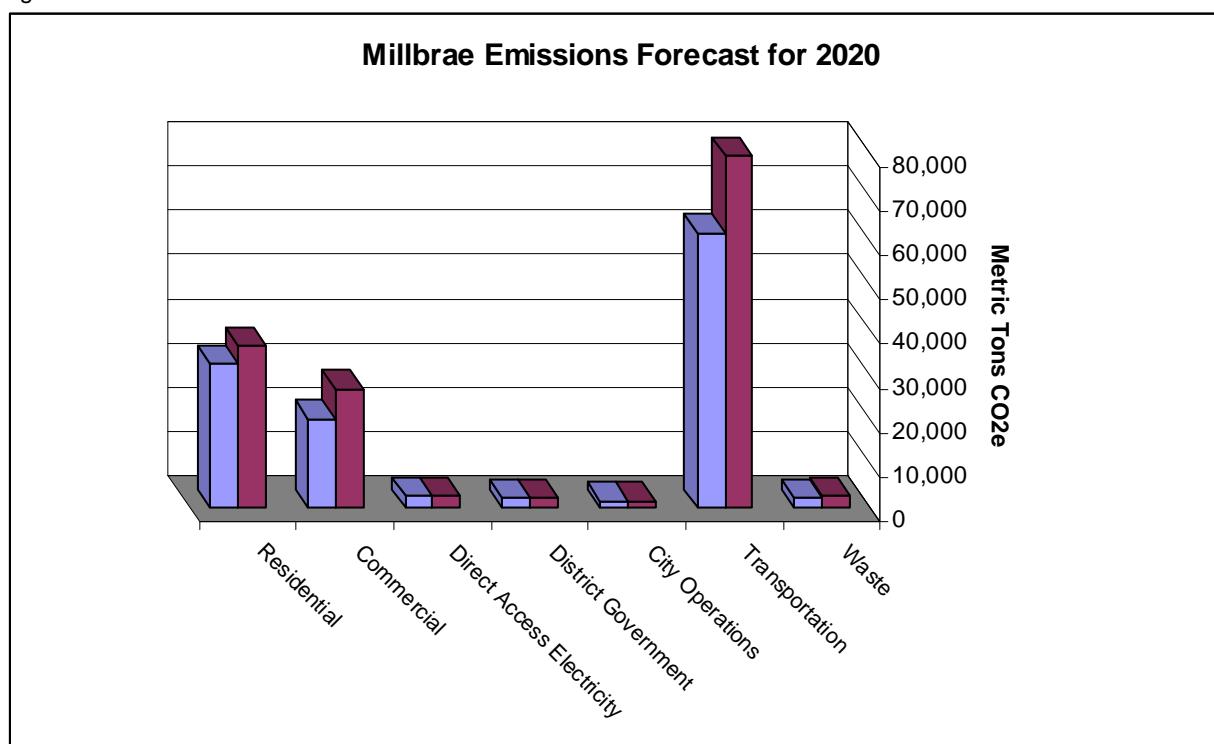
## Community Emissions Forecast

Under a business-as-usual scenario, the City of Millbrae's emissions will grow over the next decade and a half. To illustrate the potential emissions growth based on business-as-usual trends in energy use, driving habits, job growth, and population growth from the baseline year going forward, we conducted an emissions forecast for the year 2020. Table 10 and Figure 3 show the results of the forecast. On a percentage basis, emissions from the commercial sector are predicted to grow the most over the 2005 to 2020 time period. Setting aside the emissions from the vehicle travel on highways, which the City effectively cannot influence, most of the growth will occur from electricity and natural gas use in the commercial and residential sectors.

Table 10: 2005 - 2020 Community Emissions Forecast by Sector

Sector	2005 (metric tons CO <sub>2</sub> e)	2020 (metric tons CO <sub>2</sub> e)	Annual Growth Rate	Percent Change from 2005 to 2020	Absolute Change from 2005 to 2020 (metric tons CO <sub>2</sub> e)
<b>Commercial</b>	20,122	26,894	1.953%	33.7%	6,773
<b>Transportation</b>	62,141	79,431	1.650%	27.8%	17,290
<b>Residential</b>	32,405	36,615	0.818%	13.0%	4,210
<b>Waste</b>	2,466	2,787	0.818%	13.0%	321
<b>Direct Access Electricity</b>	2,727	2,727	0.000%	0.0%	0
<b>District Government</b>	2,493	2,493	0.000%	0.0%	0
<b>City Operations</b>	1,645	1,645	0.000%	0.0%	0
<b>TOTAL</b>	<b>123,999</b>	<b>152,592</b>	<b>1.5%</b>	<b>23.1%</b>	<b>28,593</b>

Figure 3: Emissions Forecast for 2020



A variety of different reports and projections were used to create the emissions forecast.

*Residential* - For the residential sector, a population projection for the City of Millbrae that was conducted by the Association of Bay Area Governments (ABAG) was used to estimate average annual growth in energy demand (0.818 %).<sup>22</sup>

*Commercial* – Analysis contained within “California Energy Demand 2008-2018: Staff Revised Forecast,” a report by the California Energy Commission (CEC), shows that commercial floor space and the number of jobs have closely tracked the growth in energy use in the commercial sector. Using job growth projections for the City of Millbrae from ABAG, it was calculated that the average annual growth in energy use in the commercial sector between 2005 and 2020 will be 1.953%.<sup>23</sup>

*Transportation* – For the transportation sector, projected growth in energy demand was obtained from the CEC. The recently passed federal Corporate Average Fuel Economy standards and the State of California’s pending tailpipe emission standards could significantly reduce the demand for transportation fuel in Millbrae. An analysis of potential fuel savings from these measures at a scale that would be useful for the purpose of this report has not been conducted, nor was it within the scope of this project to conduct such an analysis. Regardless of future changes in the composition of vehicles on the road as a result of state or federal rulemaking, emissions from the transportation sector will continue to be largely determined by growth in vehicle-miles-traveled (VMT). In their report, “Forecast of the Transportation Energy Demand, 2003-2023,” the CEC (2003) projects that on-road VMT will increase at an annual rate of 1.65% per year through 2023. This is the number that was used to estimate emission growth in the transportation sector for the Millbrae forecast.

*Waste* – As with the residential sector, the primary determinate for growth in emissions in the waste sector is population. Therefore, the average annual population growth rate for 2005 to 2020 (0.818 %)<sup>24</sup> as calculated by ABAG was used to estimate future emissions in the waste sector.

*District Government and Municipal Operations* – Data was not available for the projected growth of District, County, and City operations within the jurisdictional boundaries of Millbrae. It was therefore assumed that annual emissions from these sectors would remain unchanged between 2005 and 2020.

*Direct Access Electricity* – Because it was not possible to obtain data on the type of direct access electricity users in Millbrae, an appropriate metric for estimating emissions growth in the sector was not identified.

#### 4. Municipal Operations Emissions Inventory

In fiscal year 2004-2005<sup>25</sup>, the City of Millbrae’s municipal operations generated 1,645 metric tons of CO<sub>2</sub>e. Electricity and natural gas use in the City’s facilities resulted in 30.1% of the total greenhouse

<sup>22</sup> This growth rate was calculated based on annual growth projections from 2005 to 2020 (ABAG 2005).

<sup>23</sup> Ibid.

<sup>24</sup> Ibid

gas emissions. The vehicle fleet (20.9%), electricity used for streetlights and traffic signals (20.0%), and electricity and natural gas used to treat and pump wastewater and water (23.7%) were responsible for approximately equal shares of the total emissions. Waste (5.3%) made up the smallest share of emissions that were included in this inventory for government operations. Table 11 and Figure 4 below illustrate the breakdown of municipal emissions by source type.

During 2004-2005, the Millbrae municipal government spent approximately \$697,797 on electricity, natural gas, and fuel for its buildings, streetlights and vehicles, and waste disposal. Beyond reducing harmful greenhouse gases, any future reductions in municipal energy use have the potential to reduce this expense, enabling Millbrae to reallocate funds toward other municipal services.

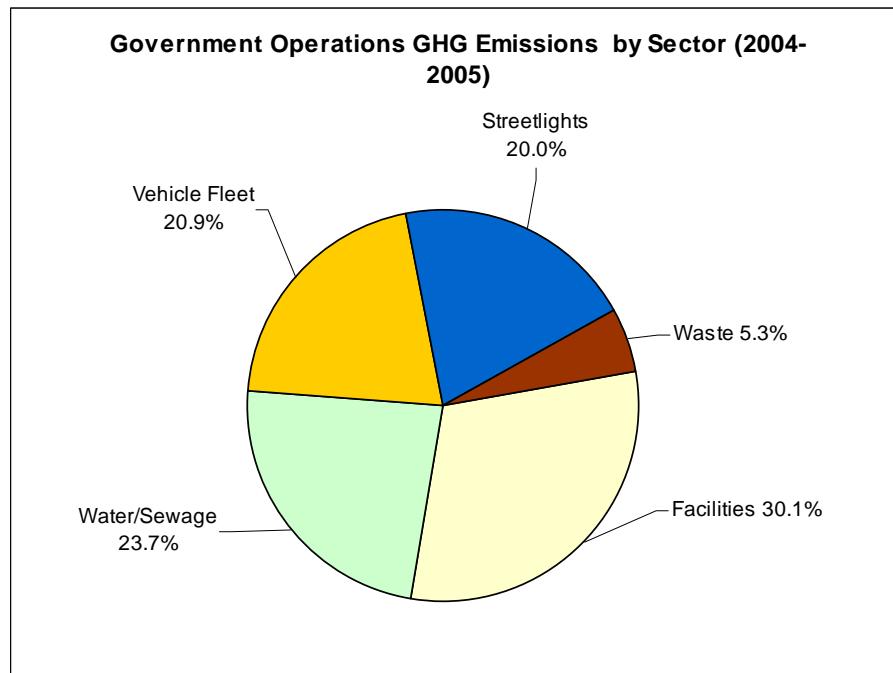
Municipal emissions in Millbrae constitute 1.3% of the community's total greenhouse gas emissions. This is not unusual; local government emissions typically account for around 2-4% of community levels. As a minor contributor to total emissions, actions to reduce municipal energy use will have a limited impact on the Millbrae community's overall emissions levels. As previously mentioned, however, municipal action has symbolic value that extends beyond the magnitude of emissions actually reduced.

Table 11: Municipal Operations Emissions Summary 2004-2005, City of Millbrae

Figure 4: Municipal Operations Greenhouse Gas Emissions in 2004-2005

	Facilities	Water/Sewage	Vehicle Fleet	Streetlights	Waste	<b>TOTAL</b>
<b>CO<sub>2</sub>e (metric tons)</b>	496	389	344	329	87	1,645
<b>Percentage of Total CO<sub>2</sub>e</b>	30.1%	23.7%	20.9%	20.0%	5.3%	0%
<b>Energy Use (MMBtu)</b>	7,869	6,600	4,427	5,028	0	23,924
<b>Cost (\$)</b>	\$175,985.00	\$168,115.00	\$100,187.17	\$175,661.00	\$77,848.36	\$697,796.53
<b>Percentage of Total Cost</b>	25.2%	24.1%	14.4%	25.2%	11.2%	100%

<sup>25</sup> The City decided to use the 2004-2005 fiscal year as a baseline for its municipal emissions inventory because internal data are tracked and compiled in fiscal years. With the exception of the Wastewater Treatment Plant, data on electricity and natural gas use were obtained directly from PG&E. At the time that data were collected for this inventory, PG&E was not able to provide data for time periods other than calendar years. Therefore, the data on electricity and natural gas use in Millbrae's facilities, for street lighting, and electricity used for pumping water separate from the wastewater treatment plant are from calendar year 2005.



Organizing the emissions by Scopes (Table 12 and Table 13) shows that 54.5% can be attributed to Scope 2 electricity use, 40.2% is from Scope 1 burning natural gas and transportation fuels, and Scope 3 waste emissions make up 5.3% of the total.

Table 12: Municipal Operations Emission Sources by Scope

Sector	Scope 1	Scope 2	Scope 3
Facilities	<i>Natural Gas, Refrigerants</i>	<i>Electricity</i>	
Vehicle Fleet	<i>Gasoline &amp; Diesel</i>		
Streetlights		<i>Electricity</i>	
Wastewater Treatment Plant and Pumping Water	<i>Fugitive Methane Emissions, Process Nitrous Oxide Emissions, Electricity Generated from Wastewater Methane</i>	<i>Electricity</i>	
Solid Waste			<i>Methane from Decomposition</i>

Table 13: Municipal Operations Emissions by Scope (Metric Tons CO<sub>2</sub>e)

Sector	Scope 1	Scope 2	Scope 3	TOTAL
Facilities	233	263		496
Vehicle Fleet	344			344
Streetlights		329		329
Wastewater / Water	85	304		389
Solid Waste			87	87
<b>TOTAL</b>	<b>661.18</b>	<b>896.31</b>	<b>86.76</b>	<b>1,645</b>
<b>Percentage of Total CO<sub>2</sub>e</b>	<b>40.2%</b>	<b>54.5%</b>	<b>5.3%</b>	<b>100%</b>

More than half of the government operations emissions came from the electricity use. This is a reflection of the large amounts of electricity used in the City's facilities, to treat and pump water, and to operate streetlights.

Table 14: Municipal Operation Emissions by Source

Source	CO <sub>2</sub> e (metric tons)	Percentage of Total CO <sub>2</sub> e	Energy Equivalent (MMBtu)
<b>Electricity</b>	896	54.4%	13,682
<b>Gasoline</b>	268	16.3%	3,480
<b>Natural Gas</b>	229	13.9%	4,282
<b>Diesel</b>	76	4.6%	967
<b>Paper Products</b>	65	4.0%	0
<b>Fugitive CH<sub>4</sub> emissions</b>	40	2.4%	0
<b>Process N<sub>2</sub>O emissions</b>	22	1.3%	0
<b>Refrigerants</b>	28	1.7%	0
<b>Food Waste</b>	9	0.6%	0
<b>Plant Debris</b>	9	0.5%	0
<b>Wood/Textiles</b>	3	0.2%	0
<b>CNG</b>	0	0.0%	1
<b>TOTAL</b>	<b>1,645</b>	<b>100%</b>	<b>22,412</b>

### ***Municipal Facilities***

The municipal facilities' relative contribution to greenhouse gas emissions is highlighted in Table 15 and Table 16. The Police Department and City Hall are responsible for 43.4% of all facilities' emissions, primarily in the form of electricity.<sup>26</sup> Due to the relatively small number of facilities, it may be possible for the City to significantly reduce its greenhouse gas emissions by focusing on improving the energy efficiency and, or generating renewable electricity for its buildings.

Table 15: Emissions from Municipal Facilities - 2005

Facility	Total CO <sub>2</sub> e (metric tons)	Percentage of Total CO <sub>2</sub> e	Electricity Use (kWh)	CO <sub>2</sub> e (metric tons)	Natural Gas Use (therms)	CO <sub>2</sub> e (metric tons)	Energy Equivalent (MMBtu)	Cost (\$)
<b>Police Station / City Hall</b>	203	43.4%	775,200	173	5,608	30	3,207	\$107,247.00
<b>Recreation Center</b>	122	26.2%	243,520	54	12,817	68	2,113	\$38,282.00
<b>1 Library Ave.</b>	84	17.9%	0	0	15,786	84	1,579	\$9,153.00
<b>Fire Department</b>	28	6.1%	54,640	12	3,039	16	490	\$8,243.00
<b>Corporation Yard</b>	27	5.7%	101,760	23	737	4	421	\$12,538.00
<b>Museum</b>	3	0.7%	0	0	592	3	59	\$522.00
<b>TOTAL</b>	<b>467</b>	<b>100%</b>	<b>1,175,120</b>	<b>263</b>	<b>38,579</b>	<b>205</b>	<b>7,869</b>	<b>\$175,985.00</b>

Fugitive emissions from air conditioning units can also be a significant part of a local government's overall greenhouse gas footprint. Due to time constraints and data availability, only the emissions from the air conditioners in the Millbrae Library were included in this analysis. For details on the methods used to estimate fugitive emissions from refrigerants, see Appendix B.

<sup>26</sup> The Police Department and City Hall are on the same electricity meter.

Table 16: Scope 1 Fugitive Emissions from Refrigerants

Equipment	Refrigerant Type	Amount (Metric Tons)	Emissions CO <sub>2</sub> e (Metric Tons)
Library Air Conditioners	R-407C	0.01863	28

### Street Lights

Municipal lighting's contribution to greenhouse gas emissions is highlighted in Table 17. Street lights, traffic signals, and parking lot lights are all sub-sectors where significant emission reductions could be realized through switching to light emitting diodes (LEDs) and, or using renewable energy to power them.

Table 17: Emissions from Streetlights, Traffic Signals, and Outdoor Lighting - 2005

Lighting Type	CO <sub>2</sub> e (metric tons)	Percentage of Total CO <sub>2</sub> e	Electricity Use (kWh)	Energy Equivalent (MMBtu)	Cost (\$)
Streetlights	180	54.6%	804,059	2,744	\$85,445.00
Traffic Signals / Cameras / Flashing Lights	76.5	23.2%	342,212	1,168	\$48,466.00
Traffic Signals - CalTrans	53.1	16.1%	237,508	811	\$29,053.00
Other Outdoor Lighting	12.0	3.7%	53,861	184	\$7,453.00
Traffic Signals / Controllers	7.94	2.4%	35,527	121	\$5,244.00
<b>TOTAL</b>	<b>329</b>	<b>100%</b>	<b>1,473,167</b>	<b>5,028</b>	<b>\$175,661</b>

### Waste

The relative contribution of landfilled waste from municipal operations to greenhouse gas emissions is highlighted in Table 18. Emissions were calculated with the CACP software using the methane commitment approach.<sup>27</sup>

Table 18: Emissions from Landfilled Municipal Solid Waste – 2004-2005

Waste Source	CO <sub>2</sub> e (metric tons)	Percentage of Total CO <sub>2</sub> e	Waste (metric tons)	Cost (\$)
Aviador Storage Facility	35.5	40.9%	127.1	\$42,322.13
400 E Millbrae (Pollution Control and Corp Yard)	20.0	23.1%	71.6	\$13,485.39
477 Lincoln Circle	17.8	20.5%	63.6	\$11,725.93
581 & 621 Magnolia	10.9	12.6%	39.1	\$7,160.24
511 Magnolia - Fire Dept	1.8	2.1%	6.5	\$1,904.53
758 Crestview - Fire Dept	0.4	0.5%	1.6	\$756.54
801 Magnolia - Library	0.3	0.3%	0.9	\$493.60
<b>TOTAL</b>	<b>87</b>	<b>100%</b>	<b>310</b>	<b>\$77,848</b>

<sup>27</sup> See Appendix B for a detailed description of the waste emissions calculation method.

## ***Wastewater and Water***

The relative contribution of indirect emissions from treating and pumping wastewater and pumping water, and the direct emissions occurring at the wastewater treatment plant to greenhouse gas emissions is highlighted in Table 19 (Scope 1 emissions) and

Table 20 (Scope 2 emissions).

Table 19: Scope 1 Wastewater Treatment Plant Emissions

Emission Type	CO <sub>2</sub> e (metric tons)	Percentage of Total CO <sub>2</sub> e
<b>Fugitive CH<sub>4</sub> emissions</b> <sup>28</sup>	40	47.6%
<b>Process N<sub>2</sub>O emissions</b> <sup>29</sup>	22	25.8%
<b>Natural Gas from PG&amp;E</b>	22	26.6%
<b>TOTAL</b>	<b>85</b>	<b>100%</b>

Table 20: Scope 2 Wastewater and Water Related Emissions 2004-2005 and 2005<sup>30</sup>

	CO <sub>2</sub> e (metric tons)	Grid Electricity Use (kWh)	Energy Equivalent (MMBtu)	Cost (\$)	Co- Generated Electricity (kWh)
<b>Wastewater Treatment Plant</b>	221	984,160	5,315	\$128,330.00	573,210
<b>Water Pumps</b>	72	321,285	1,097	\$30,154.00	
<b>Madrone Lift Station</b>	10	44,411	152	\$6,731.00	
<b>Plaza Bay Lift Station</b>	2	7,378	25	\$1,250.00	
<b>Hacienda Lift Station</b>	1	3,093	11	\$594.00	
<b>Sprinklers / Irrigation</b>	0	84	0	\$1,056.00	
<b>TOTAL</b>	<b>305</b>	<b>1,360,411</b>	<b>6,600</b>	<b>\$168,115</b>	<b>573,210</b>

## ***Vehicle Fleet***

The relative contribution of energy from Millbrae's municipal vehicle fleet to greenhouse gas emissions is highlighted in Table 21. Within municipal operations, the vehicle fleet is responsible for the second largest share of the overall emissions, with the Police and Fire Departments accounting for a combined 60% of those emissions. The use of compressed natural gas (CNG) vehicles for multiple functions has resulted in lower energy use and thus lower greenhouse gas and criteria air pollutant emissions as compared to a fleet with only gas and diesel vehicles.

<sup>28</sup> See Appendix B for an explanation of the method used to quantify methane fugitive emissions.

<sup>29</sup> Ibid

<sup>30</sup> Data on grid electricity and co-generated electricity used in the Wastewater Treatment Plant are for 2004-2005 and were provided by Joe Magner, the Manager of the Wastewater Treatment Plant. Natural gas use is for 2005 and was obtained from PG&E. Electricity data for the water pumps and sprinklers / irrigation are for 2005 and were obtained from PG&E. Data from the three lift stations are for 2004-2005 and were obtained from Joe Magner.

Table 21: Vehicle Fleet Emissions – 2004-2005

Function	CO <sub>2</sub> e (metric tons)	Percentage of Total CO <sub>2</sub> e	Gasoline Consumption (gal)	Diesel Consumption (gal)	CNG Consumption (gal)	Energy Equivalent (MMBtu)	Cost (\$)
<b>Police Vehicles</b>	131	38.2%	13,536	--	--	1,700	\$32,892
<b>Fire Department Vehicles</b>	74	21.6%	3,352	4,328		949	\$19,398
<b>Streets Vehicles</b>	30	8.7%	2,752	368	467	391	\$8,471
<b>Water Department Vehicles</b>	29	8.4%	2,562	375	3,230	368	\$12,918
<b>Storms Vehicles</b>	28	8.2%	682	2,233	2,159	358	\$11,284
<b>Collection Vehicles</b>	23	6.6%	1,744	624	368	295	\$6,512
<b>Parks</b>	11	3.3%	1,184	--	920	149	\$4,506
<b>Facilities</b>	7	2.0%	696	--	--	87	\$1,691
<b>Garage</b>	7	1.9%	682	--	--	86	\$1,657
<b>Engineering</b>	3	1.0%	353	--	--	44	\$858
<b>TOTAL</b>	<b>344</b>	<b>100%</b>	<b>27,543</b>	<b>7,928</b>	<b>7,144</b>	<b>4,427</b>	<b>\$100,187</b>

### Criteria Air Pollutants

The City of Millbrae was also responsible for the release of criteria air pollutants in fiscal year 2004-2005, as shown below. These pollutants have been linked with various environmental and public health problems. Many of the actions that can be taken to reduce greenhouse gas emissions will also have the additional benefit of reducing these pollutants as well.

Table 22: Municipal Operations Criteria Air Pollutant Emissions

	NOx (kg)	SOx (kg)	CO (kg)	VOC (kg)	PM10 (kg)
<b>Facilities</b>	767	327	375	50	269
<b>Vehicle Fleet</b>	1,200	55	8,287	884	35
<b>Streetlights</b>	592	395	375	42	326
<b>Wastewater and Water</b>	579	366	355	41	302
<b>Waste</b>	0	0	0	0	0
<b>TOTAL</b>	<b>3,139</b>	<b>1,144</b>	<b>9,392</b>	<b>1,017</b>	<b>933</b>

the past decade and a half, the City of Millbrae has been implementing a growing portfolio of sustainability strategies, many of which have significant greenhouse gas reduction co-benefits. In the past year, the City has made a formal commitment to joining the fight to stop global climate change when it became a member of ICLEI and signed the US Mayors Climate Protection Agreement. This report lays the groundwork for the climate change mitigation efforts of today and tomorrow by estimating baseline emission levels against which progress can be demonstrated.

The analysis showed that the Millbrae community as a whole was responsible for emitting 123,999 metric tons of CO<sub>2</sub>e in the base year 2005, with the transportation (50.1%) and residential (26.1%) sectors contributing the most to this total. The City of Millbrae's own municipal operations were responsible for 1,645 metric tons of CO<sub>2</sub>e in fiscal year 2004-2005, the majority of which were from the vehicle fleet (20.9%) and electricity used for outdoor lighting (20.0%) and for pumping water and wastewater (23.7%).

The results from the 2020 emissions forecast predict that under a business-as-usual scenario, emissions will grow significantly in the commercial, residential, and transportation sectors. These results suggest that energy use in commercial and residential buildings and vehicular travel on local roads present both the greatest challenge and require the most urgent action in order for the City to reduce its emissions in the future. Community climate action planning efforts should focus on these sectors.

## APPENDIX A Detailed Community Inventory Notes

**Table 23: Community-Scale Emissions Inventory Protocol Summary.** This table outlines the how the community inventory is organized by sector and scope. The first two columns show how the IPCC and ICLEI categorize the different sectors. The third and fourth columns list the key and secondary emission sources that were used in the inventory for each sector. The final three columns list the scopes that the emission sources fall within.

Macro Sector (IPCC)	Community Sector (ICLEI)	Key Emission Sources	Secondary Emission Sources	Scope 1	Scope 2	Information Item	
Energy	Stationary Combustion	Residential	Utility-delivered fuel consumption (e.g., natural gas)	Decentralized fuel consumption (e.g., propane, kerosene, fuel oil, stationary diesel, biofuels, coal)	Utility-delivered fuel consumption	Up-stream process emissions (e.g., mining/transport of coal)	
		Commercial		Decentralized fuel consumption	n/a		
		Industrial		Utility-consumed fuel for electricity / heat generation			
	Electricity / Heat Consumption	Residential	Utility-delivered electricity / heat consumption (e.g., steam)	Decentralized electricity / heat consumption not accounted for under stationary combustion (e.g., solar, geothermal)	n/a	Up-stream process emissions (e.g., mining/transport of coal)	
		Commercial					
		Industrial					
	Transportation	Transportation	Tailpipe emissions from on-road vehicles and local transit systems	Tailpipe emissions from rail, sea, pass-through highways, airports	Tailpipe emissions from on-road vehicles	Up-stream process emissions (e.g., mining/transport of oil)	
	Other Energy	Other	n/a	Tailpipe emissions from rail, sea, pass-through interstate, airports	Electricity consumption (e.g., light rail)		
	Industrial Processes and Product Use	Other	n/a	Fugitive emissions not already accounted for	Fugitive emissions not already accounted for	n/a	
	Agriculture, Forestry and Other Land Use	Agricultural Emissions	n/a	Decentralized process emissions (e.g., CO <sub>2</sub> from cement manufacture)	Decentralized process emissions	n/a	
		Land use sources and sinks	n/a	Livestock methane, managed soils, fertilizer/pesticides	Livestock methane, managed soils	n/a	
	Waste	Waste	Landfill, incineration and compost facilities Lifetime decomposition associated with waste generated	Net biogenic carbon Flux	Landfill, incineration and compost facilities Wastewater methane	n/a	
						Lifetime decomposition associated with waste generated Lifecycle process emissions (e.g., transport to the landfill)	

## Emissions from Electricity and Natural Gas Use

(Residential, Commercial, and District Sectors)

### Notes

1. The "PG&E California" electricity coefficient set is based on the 2005 PG&E CO<sub>2</sub>e emission factor of 0.49 lbs/kWh of delivered electricity. This emissions factor is certified by the California Climate Action Registry. (<https://www.climateregistry.org/CARROT/Reports/CREntityEmissionReport.aspx>)
2. Criteria air pollutant emissions factors for electricity are derived from the NERC Region 13 - Western Systems Coordinating Council/CNV Average Grid Electricity Set. These factors are from the US EPA's annual report of air pollution emission trends (USEPA 2001a).
3. The "California Coefficients for Natural Gas" coefficient set is based on a PG&E CO<sub>2</sub>e emissions factor of 11.696 lbs/therm of delivered natural gas (CEC 2005).
4. Criteria air pollutant emission factors for natural gas are derived from the US EPA's annual report of air pollution emission trends (USEPA 2001a).

#### **Data Sources**

1. Community electricity and natural gas data was provided by PG&E: Xantha Bruso, [XxB1@pge.com](mailto:XxB1@pge.com).

## **Direct Access**

#### **Notes**

Prior to the end of de-regulation in California in March 2002, many large electricity users in the state choose to enter into contracts with power providers other than the utilities that served their region, in order to secure long term fixed cost electricity prices. These power produces were located throughout California and in bordering states. In 2005, most of the direct access contracts that were signed prior to 2002 were still in effect.

The community electricity and natural gas data that was provided by PG&E indicated that direct access electricity users were present in Millbrae in 2005. PG&E was not, however, able to disclose the direct access usage because of the 15/15 rule. As a result, ICLEI used data on direct access usage in San Mateo County to estimate the amount of direct access that was used in Millbrae in 2005. This estimate was based on the percentage of total electricity used in the commercial and industrial sectors that came from direct access users. In 2005, 19.82% of the electricity used in the Commercial and Industrial sectors (10.76% overall) in San Mateo County came from direct access users.

Because the source of the direct access used is not known, emission factors for CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> for NERC Region 13 (Western Systems Coordinating Council/CNV Region), which includes all of California and most of Nevada. Aggregated to CO<sub>2</sub>e, this factor is 0.6866 pounds per kWh.

The 15/15 Rule was adopted by the CPUC in the Direct Access Proceeding (CPUC Decision 97-10-031) to protect customer confidentiality. The 15/15 rule requires that any aggregated information provided by the Utilities must be made up of at least 15 customers and a single customer's load must be less than 15 percent of an assigned category. If the number of customers in the complied data is below 15, or if a single customer's load is more than 15 percent of the total data, categories must be combined before the information is released.

To obtain actual data on direct access electricity usage in Millbrae would require identifying who the customers were and asking them to share the details of their use.

#### **Data Sources**

1. Community electricity and natural gas data was provided by PG&E: Xantha Bruso, [XxB1@pge.com](mailto:XxB1@pge.com).
2. California Energy Commission (CEC): Andrea Gough, [agough@energy.state.ca.us](mailto:agough@energy.state.ca.us)

## **Transportation Sector**

### **Emission Factors for VMT on Local Roads and Highways**

#### **Notes**

1. Greenhouse gas emission factors were calculated using “Burden Model” within EMFAC2007 for San Mateo County in 2005. This includes all registered vehicles on the road that were built from 1965 to 2005. The emission factors were calculated by Amir Fanai, Bay Area Air Quality Management District (8/14/07)

CO <sub>2</sub> Rates- (grams/mile)			CO <sub>2</sub> Rates- (grams/gallon)		
Gasoline	Diesel	Average	Gasoline	Diesel	Average
440	1,269	467	8,609	10,216	8,729

CH <sub>4</sub> Rates- (grams/mile)		
Gasoline	Diesel	Average
0.058	0.030	0.056

N <sub>2</sub> O Rates- (grams/mile)		
Gasoline	Diesel	Average
0.070	0.050	0.069

VMT Mix		Fuel Usage		Fuel Efficiency (miles/gallon)		
Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Average
96.8%	3.2%	92.5%	7.5%	19.6	8.1	18.7

2. Criteria air pollutant emissions factors are from the CACP Software, which are based on the US EPA’s annual report of air pollution emission trends (USEPA 2001a).

### **Local Roads Vehicle Miles Traveled**

#### **Notes**

1. Local Roads Vehicle Miles Traveled (VMT) 2005 data was obtained from CalTrans, which compiles and published statewide VMT data annually. The 2005 report is available at:

<http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/hpmspdf/2005PRD.pdf>.

2. CalTrans obtains local roads VMT data from regional transportation planning agencies and councils of governments across the state. For the San Francisco Bay Area, CalTrans obtains data from the Metropolitan Transportation Commission (MTC). MTC obtains data on local roads VMT from the local governments within its jurisdiction. Each local government monitors VMT on roads within their boundaries using assorted methods.

### **Highway Vehicle Miles Traveled**

#### **Notes**

1. City level state highway VMT data was compiled by Theresa Krebs and Micah Lang at ICLEI using an unpublished CalTrans dataset that was obtained from Benjamin Espinosa, Transportation Planner at MTC (BEspinosa@mtc.ca.gov).

#### **Overview of the Method used by ICLEI:**

- The Metropolitan Transportation Commission (MTC) provided ICLEI with average daily miles traveled per highway segment for all highways in the Bay Area. This data was collected through the Highway Performance Monitoring System (HPMS), which in California is operated by CalTrans. Highway segments range in length from a few hundred yards up to ten miles depending on the occurrence of major intersections and county boundaries.
- Electronic base maps that contain jurisdictional boundaries, streets, and highways compatible with the ArcGIS software suite were obtained from Alameda, Contra Costa, Marin, Santa Clara, and San Mateo Counties.
- The highway segment data was imported into ArcGIS.
- Polygons (shape files) were created for the unincorporated areas and cities of each county, so that there was a polygon for each jurisdiction within the two counties.

- Segments that cross city-city boundaries and city-unincorporated boundaries were cut at the boundary.
- Segments that fall on a border were cut in half and manually divided between the two jurisdictions.
- With all segments now falling exclusively within a single jurisdiction, each segment was assigned to one jurisdiction.
- The Daily Vehicle Miles Traveled (DVMT) for each segment was grouped by jurisdiction and summed.
- DVMT was multiplied by 365 to obtain Annual Vehicle Miles Traveled (AVMT).
- AVMT was multiplied by county-specific emission factors for metric tons of CO<sub>2</sub>e per vehicle mile traveled to obtain total metric tons of CO<sub>2</sub>e.
- The emission factors were obtained from the Emission Factors Model (EMFAC), which was created by the California Air Resources Board. The emission factor for each county is based on an extensive list of measured and modeled inputs including the composition of registered vehicles on the road and the emission of greenhouse gases for each vehicle type from different driving conditions (such as starting, normal driving, and idling) and climactic conditions. EMFAC produces county-specific emission factors for each calendar year.

## CalTrain

### Notes

Emissions estimates are for trains traveling within the City Limits of Millbrae in 2005

- Miles of CalTrain Track in Millbrae: 1.3 miles Northbound + 1.3 miles Southbound = 2.6 miles.
- On average, CalTrain engines use 3.13 gallons of diesel per mile traveled. (from Budget FY 2004-2005 CalTrain)
- Number of trains passing through Millbrae (From: 2005 CalTrain Ridership Report)  
 Weekday = 43 northbound + 43 southbound = 86 x 5 days = 430 trains weekly  
 Saturday = 16 northbound + 16 southbound = 32 trains weekly  
 Sunday = 15 northbound + 15 southbound = 30 trains weekly  
 $(430 + 32 + 30) \times 52 \text{ weeks} = 22,360 \text{ trains passed through Millbrae in 2005}$
- Miles of train travel in Millbrae = 22,360 x 1.3 miles = 29,068 miles
- Total fuel consumed in the Millbrae city limits = 29,068 miles x 3.13 gallons of diesel/mile = **90,983 gallons of diesel.**

## Waste Sector

### Notes

1. CO<sub>2</sub>e emission were calculated using the methane commitment method in the CACP software, which uses a version of the EPA WARM model. This model has the following general formula:

$$\text{CO}_2\text{e} = W_t * (1-R)A$$

Where:

**W<sub>t</sub>** is the quantify of waste type 't',

**R** is the methane recovery factor,

**A** is the CO<sub>2</sub>e emissions of methane per metric ton of waste at the disposal site (the methane factor)

2. A methane recovery factor (R) of 75% was used in the model. While Ox Mountain Landfill—the site where 97% of Millbrae's waste is disposed—reports that they have a methane recovery rate of 99.61%, this number is overly optimistic for a number of reasons. The landfill gas accounting methodology approved by the Intergovernmental Panel on Climate Change (IPCC) specified that methane recovery "should only be reported when references documenting the amount of methane are available," and that "recovery based on metering of all gas recovered... is consistent with good practice" (IPCC 2006). This documentation was not available for Ox Mountain Landfill. ICLEI chose to use a methane recovery factor of 75% in accordance with EPA's AP 42 guidance on typical rates of recovery for US landfills that employ full landfill gas capture systems (EPA 1998).

### **Data Sources**

1. California Integrated Waste Management Board collects quarterly data on the tonnage, origin, and destination of solid waste that is disposed of in California. Data on Millbrae was obtained from:

<http://www.ciwmb.ca.gov/LGCentral/DRS/Reports/JurDspFa.asp>

2. The composition of landfilled waste was obtained from a statewide waste characterization study conducted in 2003 and 2004: CIWMB 2004 Statewide Waste Characterization Study. This state average waste characterization accounts for residential, commercial and self haul waste. <http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1097>

## APPENDIX B Detailed Government Inventory Notes

**Table 24: Government Operations Emissions Inventory Protocol Summary Chart.** This table outlines the how the government operations inventory is organized by sector and scope. The first two columns show how the IPCC and ICLEI categorize the different sectors. The third and fourth columns list the key and secondary emission sources that were used in the inventory for each sector. The final three columns list the scopes that the emission sources fall within.

Macro Sector (IPCC)	Government Sector (ICLEI)	Key Emission Sources	Secondary Emission Sources	Scope 1	Scope 2	Information Item
Energy	Stationary Combustion	Buildings and Facilities	Utility-delivered fuel consumption (e.g., natural gas)			Stationary Emissions from facilities operated by municipally contracted businesses performing essential municipal services
		Water/Sewer System	Decentralized fuel consumption (e.g., propane, kerosene, fuel oil, stationary diesel, biofuels, coal)	Utility-consumed fuel for electricity / heat generation	n/a	Up-stream process emissions (e.g., mining/transport of coal)
	Electricity / Heat Consumption	Buildings and Facilities	Utility-delivered electricity / heat consumption (e.g., steam)	Decentralized electricity / heat consumption not accounted for under stationary combustion (e.g., solar, geothermal)	n/a	Emissions from facilities operated by municipally contracted businesses performing essential municipal services
		Street lights and traffic signals				Up-stream process emissions (e.g., mining/transport of coal)
		Water/Sewer				
	Mobile Combustion	Vehicle Fleet	Tailpipe emissions from municipally owned and operated vehicles		n/a	Tailpipe emissions from vehicles operated by municipally contracted businesses performing essential services
		Employee Commute	n/a	Tailpipe emissions from vehicles operated by municipal employees traveling to and from work	n/a	Tailpipe emissions from vehicles operated by municipal employees traveling to and from w/prk
	Fugitive emissions	Other	n/a	Fugitive emissions from energy	n/a	Lifecycle and/or embodied energy from material procurement
Industrial Processes and Product Use	Other	n/a	Fugitive emissions from industrial processes	Fugitive emissions from industrial processes	n/a	Lifecycle process emissions
Agriculture, Forestry and Other Land Use	Other	n/a	methane from government owned livestock	n/a	n/a	n/a
	Other	n/a	Net biogenic carbon Flux on municipally owned land	Net biogenic carbon flux	n/a	n/a
Waste	Waste	Municipally operated Landfill, incineration and compost facilities  Lifetime decomposition associated with waste generated by municipality	Wastewater methane	Landfill, incineration and compost facilities  Wastewater methane	n/a	Lifetime decomposition associated with waste generated  Lifecycle process emissions (e.g., transport to the landfill)

Facilities and Streetlights

## Notes

1. The "PG&E California" electricity coefficient set is based on the 2005 PG&E CO<sub>2</sub>e emission factor of 0.49 lbs/kWh of delivered electricity. This emissions factor is certified by the California Climate Action Registry.  
(<https://www.climateregistry.org/CARROT/Reports/CREntityEmissionReport.aspx>)
2. Criteria air pollutant emissions factors for electricity are derived from the NERC Region 13 - Western Systems Coordinating Council/CNV Average Grid Electricity Set in the CACP Software (USEPA 2001a).
3. The "California Coefficients for Natural Gas" coefficient set is based on a PG&E CO<sub>2</sub>e emissions factor of 11.696 lbs/therm of delivered natural gas (CEC 2005).
4. Criteria air pollutant emissions factors for natural gas are derived from the CACP Software, which are based on the US EPA's annual report of air pollution emission trends (USEPA 2001a).
5. Fugitive refrigerant emissions from the air conditioners in the Millbrae Library were calculated using the alternate method in the Local Government Operations Protocol (CARB et al 2008), which draws from the method used by the US EPA for national-level greenhouse gas inventories (IPCC 2006, Volume 3, Table 7.9). In equation 6.33 below, the following variables were estimated using default values for Residential and Commercial A/C equipment from Table 6.3: **k**, **x**, **y**, and **z**.

Equation 6.33	Estimating Emissions of Each Type of Refrigerant								
For each type of refrigerant:									
<b>Total Annual Emissions</b> = $[(C_N \times k) + (C \times x \times T) + (C_D \times y \times (1 - z))] \div 1,000$									
(metric tons)	(kg)	(%)	(kg)	(%)	(years)	(kg)	(%)	(%)	(kg/metric ton)
Where:									
C <sub>N</sub> = quantity of refrigerant charged into the new equipment <sup>1</sup>									
C = total full charge (capacity) of the equipment									
T = time in years equipment was in use (e.g., 0.5 if used only during half the year and then disposed)									
C <sub>D</sub> = total full charge (capacity) of equipment being disposed of <sup>2</sup>									
k = installation emission factor <sup>1</sup>									
x = operating emission factor									
y = refrigerant remaining at disposal <sup>2</sup>									
z = recovery efficiency <sup>2</sup>									
<sup>1</sup> Omitted if no equipment was installed during the reporting year or the installed equipment was pre-charged by the manufacturer									
<sup>2</sup> Omitted if no equipment was disposed of during the reporting year									

**Table 6.3 Default Emission Factors for Refrigeration / Air Conditioning Equipment**

Type of Equipment	Capacity (kg)	Installation Emission Factor k (% of capacity)	Operating Emission Factor x (% of capacity / year)	Refrigerant Remaining at Disposal y (% of capacity)	Recovery Efficiency z (% of remaining)
Domestic Refrigeration	0.05 - 0.5	1 %	0.5 %	80 %	70 %
Stand-alone Commercial Applications	0.2 - 6	3 %	15 %	80 %	70 %
Medium & Large Commercial Refrigeration	50 - 2,000	3 %	35 %	100 %	70 %
Industrial Refrigeration including Food Processing and Cold Storage	10 - 10,000	3 %	25 %	100 %	90 %
Chillers	10 - 2,000	1 %	15 %	100 %	95 %
Residential and Commercial A/C including Heat Pumps	0.5 - 100	1 %	10 %	80 %	80 %

Source: IPCC, *Guidelines for National Greenhouse Gas Inventories* (2006), Volume 3: Industrial Processes and Product Use, Table 7.9.

Note: Emission factors above are the most conservative of the range provided by the IPCC. The ranges in capacity are provided for reference. You should use the actual capacity of your equipment. If you do not know your actual capacity, you should use the high end of the range provided (e.g., use 2,000 kg for chillers).

**Data Sources**

1. Data provided by PG&E: Lynne Galal, [L1G7@pge.com](mailto:L1G7@pge.com), and Corie Cheeseman, [C3CL@pge.com](mailto:C3CL@pge.com).

**Vehicle Fleet****Notes**

1. Greenhouse Gas Emissions and Fuel Use Data are from the US EPA's national greenhouse gas inventory (USEPA 2001c).
2. Criteria air pollutant emissions levels are from the US EPA's annual report of air pollution emission trends (USEPA 2001a).
3. Fuel prices for diesel, gasoline, and CNG were back-calculated based on aggregate costs and gallons used for the 2004-2005 fiscal year.

**Data Sources**

1. Data provided by: Dino Campagna, Public Works Supervisor II, City of Millbrae, [dcampagna@ci.millbrae.ca.us](mailto:dcampagna@ci.millbrae.ca.us)
2. Data on fuel used by the Millbrae Fire Department was provided by Jerry Goff: [jgoff@ci.millbrae.ca.us](mailto:jgoff@ci.millbrae.ca.us)

**Wastewater and Water**

**Notes**

1. Data on grid electricity and co-generated electricity used in the Wastewater Treatment Plant is for 2004-2005 and was provided by Joe Magner, the Manager of the Wastewater Treatment Plant. Natural gas use is for 2005 and was obtained from PG&E. Electricity data for the water pumps and sprinklers / irrigation is for 2005 and was obtained from PG&E. Data from the three lift stations is for 2004-2005 and was obtained from Joe Magner.
2. For the purpose of this inventory, electricity generated at the Millbrae Wastewater Treatment Plant through the combustion of methane and waste grease was considered to be carbon neutral. In the CACP Software, this electricity was entered using the fuel source type category "Green Electricity."
3. The "PG&E California" electricity coefficient set is based on the 2005 PG&E CO<sub>2</sub>e emission factor of 0.49 lbs/kWh of delivered electricity. This emissions factor is certified by the California Climate Action Registry. (<https://www.climateregistry.org/CARROT/Reports/CREntityEmissionReport.aspx>)
4. Criteria air pollutant emissions factors for electricity are derived from the NERC Region 13 - Western Systems Coordinating Council/CNV Average Grid Electricity Set. These factors are from the US EPA's annual report of air pollution emission trends (USEPA 2001a).
5. The "California Coefficients for Natural Gas" coefficient set is based on a PG&E CO<sub>2</sub>e emissions factor of 11.696 lbs/therm of delivered natural gas (CEC 2005).
6. Criteria air pollutant emissions factors for natural gas are derived from the CACP Software, which are based on the US EPA's annual report of air pollution emission trends (USEPA 2001a).
7. Fugitive methane emissions from the Millbrae Wastewater Treatment Plant in Table 19 were calculated according to the alternate method in the Local Government Operations Protocol (CARB et al 2008), which draws from the method used by the US EPA for national-level greenhouse gas inventories (US EPA 2008).

<b>Equation 10.2</b>	Stationary CH <sub>4</sub> from Incomplete Combustion of Digester Gas (default)
Annual CH <sub>4</sub> emissions (metric tons) =	
	$P \times \text{Digester Gas} \times F_{CH_4} \times \rho(CH_4) \times (1-DE) \times 0.0283 \times 365.25 \times 10^{-6}$

where:

<b>Term</b>	<b>Description</b>	<b>Value</b>
P	= population served by the WWTP with anaerobic digesters	user input
Digester Gas	= cubic feet of digester gas produced per person per day [ft <sup>3</sup> /person/day]	1.0
F <sub>CH<sub>4</sub></sub>	= fraction of CH <sub>4</sub> in biogas	0.65
$\rho(CH_4)$	= density of methane [g/m <sup>3</sup> ]	662.00
DE	= CH <sub>4</sub> Destruction Efficiency	.99
0.0283	= conversion from ft <sup>3</sup> to m <sup>3</sup> [m <sup>3</sup> /ft <sup>3</sup> ]	0.0283
365.25	= conversion factor [day/year]	365.25
$10^{-6}$	= conversion from g to metric ton [metric ton/g]	$10^{-6}$

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2006*, Chapter 8, 8-9 (2008).

8. Process nitrous oxide emissions from the Millbrae Wastewater Treatment Plant in Table 19 were calculated according to the method in the Local Government Operations Protocol (CARB et al 2008), which draws from the method used by the US EPA for national-level greenhouse gas inventories (US EPA 2008).

### 10.3.2.1 Process Emissions from WWTP with Nitrification/Denitrification

<b>Equation 10.7</b>	Process N <sub>2</sub> O Emissions from WWTP with Nitrification/Denitrification
Annual N <sub>2</sub> O emissions (metric tons) =	
$P_{\text{total}} \times \text{EF nit/denit} \times 10^{-6}$	

where:

Term	Description	Value
P <sub>total</sub>	= total population that is served by the centralized WWTP adjusted for industrial discharge, if applicable [person]	user input
EF nit/denit	= emission factor for a WWTP with nitrification/denitrification [g N <sub>2</sub> O/person/year]	7
10 <sup>-6</sup>	= conversion from g to metric ton [metric ton/g]	10 <sup>-6</sup>

Source: EPA *Inventory of US Greenhouse Gas Emissions and Sinks: 1990-2006*, Chapter 8, 8-14 (2008).

#### Data Sources:

1. Joe Magner, Wastewater Treatment Plant Manager. [jmagner@ci.millbrae.ca.us](mailto:jmagner@ci.millbrae.ca.us).
2. Data provided by PG&E: Lynne Galal, [L1G7@pge.com](mailto:L1G7@pge.com), and Corie Cheeseman, [C3CL@pge.com](mailto:C3CL@pge.com).

## Waste

### Notes

Table 25: Emissions from Landfilled Municipal Solid Waste - 2004-2005

Account Number	Waste Source	CO <sub>2</sub> e (metric tons)	Percentage of Total CO <sub>2</sub> e	Quantity of Waste (metric tons)	Diversion Rate (estimated)
26561	<b>Aviador Storage Facility</b>	35.5	40.9%	127.1	50%
31920 and 20521	<b>400 E Millbrae (Pollution Control and Corp Yard)</b>	20.0	23.1%	71.6	40%
26559	<b>477 Lincoln Circle</b>	17.8	20.5%	63.6	40%
25624	<b>621 Magnolia</b>	10.9	12.6%	39.1	40%
26396	<b>511 Magnolia - Fire Dept</b>	1.8	2.1%	6.5	40%
31906	<b>758 Crestview - Fire Dept</b>	0.4	0.5%	1.6	0%
47653	<b>801 Magnolia - Library</b>	0.3	0.3%	0.9	0%
	<b>TOTAL</b>	<b>87</b>	<b>100%</b>	<b>310</b>	<b>-</b>

1. Prior to converting the tonnage of waste into equivalent greenhouse gas emissions, it was necessary to estimate the percentage of waste from each location that was being recycled or composted (the diversion rate). These diversion rates were estimated by Shelly Reider, Recycling Coordinator for the City of Millbrae. The “Quantity of Waste” numbers in Table 19 are post-diversion.
  - a. For the following accounts, diversion rate from landfill was estimated at 40%: 25624, 26559, 26396, 31920, 20521.
  - b. A 50% diversion rate was estimate for account 26561.
  - c. The following accounts had estimated diversion rates from landfill of 0%: 31906, 47653.

2. Waste Composition data was not available for Millbrae's municipal waste accounts. Waste Composition Data is from: Waste Characterization: CIWMB 2004 Statewide Waste Characterization Study. This state average waste characterization accounts for residential, commercial and self haul waste. <http://www.ciwmb.ca.gov/Publications/default.asp?pubid=1097>

**Data Sources**

1. Shelly Reider, Recycling Coordinator, City of Millbrae, [sreider@ci.millbrae.ca.us](mailto:sreider@ci.millbrae.ca.us)

## APPENDIX C Emission Factor Sets

### Average Grid Electricity Set

Units: Pounds/kWh

Year	CO <sub>2</sub> e	N <sub>2</sub> O	CH <sub>4</sub>	NOx	SOx	CO	VOC	PM <sub>10</sub>
2005	0.4928591	0	0	0.000887	0.000591	0.000561	6.31E-05	0.000488

*Data Sources*

1. CO<sub>2</sub>e data are from PG&E California
2. Criteria air pollutant emissions factors for electricity are derived from the NERC Region 13 - Western Systems Coordinating Council/CNV Average Grid Electricity Set. These factors are from the US EPA's annual report of air pollution emission trends (USEPA 2001a).

*Sectors*

Community Analysis: Residential and Commercial

Government Operations Analysis: Facilities, Streetlights, Wastewater/Water

### Direct Access

Units: Pounds/kWh

Year	CO <sub>2</sub>	N <sub>2</sub> O	CH <sub>4</sub>	NOx	SOx	CO	VOC	PM10
2005	0.6866	7.06E-05	5.45E-05	0.000887	0.000591	0.000561	6.31E-05	0.000488

*Data Sources:*

1. NERC Region 13 - Western Systems Coordinating Council/CNV" Grid Average set included in the CACP software (USEPA 2001a).

*Sectors*

Community Analysis: Direct Access

### Natural Gas Coefficients – Stationary Set

Units - Pounds/Therm

Sector	Year	CO <sub>2</sub>	N <sub>2</sub> O	CH <sub>4</sub>	NOx	SOx	CO	VOC	PM10
Commercial	2005	11.6955	0.00022	0.001301	0.016801	0.000669	0.004338	0.000925	0.000514
Residential	2005	11.6955	0.00022	0.001301	0.017557	0.000669	0.004338	0.000925	0.000514

*Data Sources*

1. CO<sub>2</sub>, N<sub>2</sub>O, and CH<sub>4</sub> data are from the California Energy Commission and PG&E (CEC 2005).
2. Coefficients for calculating criteria air pollutants are taken from NERC Region 13 - Western Systems Coordinating Council/CNV set included in CACP software (USEPA 2001a)

*Sectors*

Community Analysis: Residential and Commercial

Government Operations Analysis: Facilities, Streetlights, Wastewater/Water

### Transportation – VMT Set

Units - Grams/Mile

Year	Fuel Type	CO <sub>2</sub>	N <sub>2</sub> O	CH <sub>4</sub>	NOx	SOx	CO	VOC	PM10
2005	Gasoline	440	0.07	0.058	1.458	0.0908	16.497	1.701	0.03172
2005	Diesel	1,269	0.05	0.03	12.479	0.487	9.564	1.227	0.49434

*Data Sources*

1. Emission coefficients for CO<sub>2</sub>, N<sub>2</sub>O, and CH<sub>4</sub> are from EMFAC2007, calculated by Amir Fanai, Bay Area Air Quality Management District (8/14/07)

Emission factors were calculated using “Burden Model” within EMFAC2007 for San Mateo County in 2005. This includes all registered vehicles on the road that were built from 1965 to 2005.

2. Coefficients for calculating criteria air pollutants are taken from the USA Default set included in CACP software. For gasoline, coefficients are for “Passenger Vehicles.” For diesel, coefficients are for “Heavy Trucks.”

- NOx and VOC: (USEPA 2001d)
- PM-10: (DeCicco and Kliesch 2001)
- CO: (USEPA 1999)
- SOx: derived from the EPA (1995)

*Sectors*

Community Analysis: Transportation

**Transportation – Fuel Usage Set**

Units: Grams/Gallon

Fuel Type	Vehicle Class	Fuel Efficiency (miles/gallon)	CO <sub>2</sub>	N <sub>2</sub> O	CH <sub>4</sub>	NOx	SOx	CO	VOC	PM <sub>10</sub>
Gasoline	Auto-Full Size	18.61	9,393	0.052	0.051	1.475	0.079	15.82	1.622	0.034
Gasoline	Auto-Mid Size	19.97	9,393	0.052	0.051	1.475	0.079	15.82	1.622	0.034
Gasoline	Auto-Sub-Compact / Compact	25.65	9,393	0.052	0.051	1.475	0.079	15.82	1.622	0.034
Gasoline	Heavy Truck	4.84	9,393	0.125	0.174	4.176	0.186	40.566	3.924	0.102
Gasoline	Light Truck / SUV / Pickup	13.72	9,393	0.072	0.065	1.439	0.104	17.27	1.792	0.029
Gasoline	Motorcycle	25.19	9,393	0.007	0.219	0.85	0	23.55	2.95	0
Gasoline	Passenger Vehicle	17.7	9,393	0.062	0.057	1.458	0.091	16.497	1.701	0.032
Diesel	Heavy Truck	5.63	9,511	0.048	0.068	12.479	0.487	9.564	1.227	0.494
Diesel	Light Truck / SUV / Pickup	16.86	9,511	0.032	0.016	1.108	0.158	1.169	0.403	0.196
Diesel	Rail - Commuter	3.61	9,511	0.067	0.21	50.914	9.38	6.982	2.65	1.682
CNG	Light Truck / SUV / Pickup	15.3	7.624	0.037	0.039	0.086	0.002	4.138	0.071	0.009
CNG	Heavy Truck	6.93	7.624	0.019	1.071	4.868	0.065	11.432	1.977	0.016

*Data Sources*

1. Coefficients for calculating criteria air pollutants are taken from the USA Default set included in CACP software.

Emission factors for gasoline fueled light duty vehicles

- NOx and VOC: (USEPA 2001d)
- PM-10: (DeCicco and Kliesch 2001)
- CO: (USEPA 1999)
- SO<sub>2</sub>: derived from (USEPA 1995)

Emission factors for gasoline fueled heavy duty vehicles

- NOx, VOC, CO: (USEPA 2001b, Appendix H)
- PM-10: (DeCicco and Kliesch 2001)
- SOx: derived from (USEPA 1995)

Emission factors for diesel fueled light duty vehicles

- NOx, VOC, CO, PM-10: (DeCicco and Kliesch 2001)
- SOx: derived from (USEPA 1995)

Emission factors for diesel fueled heavy duty vehicles

- NOx, VOC, CO: (USEPA 2001b, Appendix H)
- PM-10: (DeCicco and Kliesch 2001)
- SOx: derived from (USEPA 1995)

Emission factors for compressed natural gas (CNG) vehicles

- All emission factors from (ANL 2001)

2. Greenhouse Gas Emissions and Fuel Use Data are from the US EPA's national greenhouse gas inventory (USEPA 2001a).

*Sectors*

Community Analysis: Transportation – CalTrain

Government Operations Analysis: Vehicle Fleet

## APPENDIX D – References

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## APPENDIX E - Chronological List of the City's Climate Protection Programs

### Climate Protection Programs

#### **Summary**

The City of Millbrae has a number of programs in place to reduce greenhouse gas emissions, including reducing waste, conserving water, using compressed natural gas vehicles for the City's fleet, installing energy efficiencies in City facilities and LED lights in traffic lights, participating in the Spare the Air Program and notifications, planting 100 trees annually for Arbor Day, providing rebates for installation of photovoltaic systems, using waste grease to provide energy at the Treatment Plant and adopting the Sustainable Food Service Ware Ordinance that bans polystyrene foam and solid food service ware and requires the use of recyclable, reusable or biodegradable/compostable food ware for use by food vendors, including restaurants, cafes, grocery stores and City Departments and facilities.

The City of Millbrae has a long-standing commitment to the environment and sustainability. Current community and municipal operations to reduce greenhouse gas emissions include a recycling and waste prevention program that in 2005 and 2006 achieved a 67% diversion rate and a wastewater treatment plant that runs on brown kitchen grease.

Through our Sustainable Millbrae Program we continue to explore and implement new systems designed to further enhance our quality of life by means of the long-term improvement of our environment, economy, and social well-being.

#### **Historical Listing**

##### 1994:

- Established the Recycling & Waste Prevention Program to comply with AB 939, the Integrated Waste Management Act, and to implement programs.
- Became a "Tree City" and began planting 100 trees annually for Arbor Day.
- Developed the Millbrae Station Area Specific Plan that includes land use policies for developing residential and commercial development near transit.

##### 1995:

- Started backyard and worm composting workshops.

##### 1997:

- Began participating in the Spare the Air Program and distributing notifications.

##### 1998:

- Began installing energy efficiencies in City facilities.
- Began collecting yard waste at the curbside for residents.
- Started organic gardening workshops.

##### 1999:

- Purchased natural gas vehicles for the City's fleet.
- Implemented construction and demolition reuse and recycling requirements.

##### 2000:

- Installed LED lights in traffic lights
- Began implementing Pollution Prevention Week activities and programs.

##### 2003:

- Started Earth Friendly Home & Garden Seminars.

**OVER**

##### 2006:

- Developed the Sustainable Millbrae Program to develop and implement programs for our community to improve the health of our citizens and the environment.
- Began a bio-gas operation to use brown kitchen waste grease to provide energy at the Treatment Plant.
- Achieved a 67% waste reduction and recycling diversion rate (AB 939).

**2007:**

- Adopted two Climate Protection Pledges/Campaigns: US Mayors and ICLEI - Cities for Climate Protection.
- Began participating in the Silicon Valley Joint Venture Climate Task Force to implement regional programs.
- Began Climate Protection outreach programs, including setting up a display in City Hall with handouts, publishing an article in the City residential newsletter and airing public service announcements on the local cable station.
- Planted 300 trees on a main thoroughfare, El Camino Real Street.
- Started a Solar Rebate Program.
- Began new outreach on Green Building with targeted brochures.
- Began participating in a Green Business Program to certify businesses. Four businesses were certified.
- Adopted the Sustainable Food Service Ware Ordinance banning polystyrene foam and solid food service ware and requires the use of recyclable, reusable or biodegradable/compostable food ware for use by food vendors, including restaurants, cafes, grocery stores and City Departments and facilities. This went into effect on January 1, 2008.
- Distributed 2,500 reusable tote shopping bags to date made from recycled plastic bottles to reduce the number of plastic bags used and littered.
- Implemented linen and towel reuse programs at three hotels and motels to conserve water and energy.

**2008:**

- Developed a greenhouse gas inventory report via a contract with ICLEI. Work began to outline strategies to implement in the short term.
- Signed onto PG&E's ClimateSmart Program to offset greenhouse gas emissions from City operations.
- Signed onto San Francisco Community Power's Energy Alert Day program for City hall (includes the Police Station) and Community Center. Participated in one alert day and reduced energy use by 9% (25 kilowatts) at City Hall.
- Started using 100% post-consumer copy paper at City facilities.
- Conducted a City wide paper reduction campaign and reduced paper purchases from the previous year by 11 cases.
- Placed recycling containers for the public in the downtown area for the collection of cans and bottles and mixed paper.
- Installed water saving devices at City facilities including kitchen and bathroom aerators and showerheads.
- Certified City Hall as a Green Business. Conducted outreach to businesses to participate.
- Switched to integrated pest management for indoor City facilities.
- Started a City employee Commuter Options and Incentives Program. Conducted an employee commute survey to learn of transportation methods to and from work to help in developing a comprehensive program to reduce single car occupancy travel. Conducted outreach to employees on public transportation options and incentives.
- Began participating in the County's new program, CO2 San Mateo County that includes developing an energy and water strategy.

**Other Related Programs**

**Water Resources and Conservation Program**

The Water Resources and Conservation Program provides the following resources to residents, businesses and schools to reduce water consumption. Programs are also in place to reduce City facility water consumption.

- High efficiency toilet and clothes washer rebates
- Newsletters, brochures and flyers on conserving water and water wise and native plant gardening
- Native Plant Landscaping and Irrigation Workshops

- Commercial landscape water audits and reports
- Water conserving device handouts: bathroom and kitchen faucet aerators, showerheads, shower timers, water leak tablets, sprinkler gauges, water-wise garden CD

### Recycling & Waste Prevention

The Recycling & Waste Prevention Program provides a variety of programs and resources for residents, businesses, schools and city departments to reduce the amount of waste placed in landfills. AB 939 requires cities and counties to reduce waste by at least 50%. Since 1999, the City has achieved and surpassed the 50% waste reduction requirement goal. For 2006, the last reporting year, the City achieved a 67% diversion rate.

The City conducts waste prevention and recycling programs for the community to provide opportunities for the many ways to reduce, reuse, recycle and buy recycled products. Another focus is to reduce the amount of household hazardous waste that is used and disposed of in landfills, outreach on proper disposal, and to educate on non-toxic alternatives.

- A detailed program description is available.

### Programs in Progress:

- Working with ICLEI to identify goals and strategies.
- Working with the Silicon Valley Joint Venture Climate Task Force and CO2 San Mateo County to implement regional programs.
  - The Task Force is implementing a Sustainable Buildings Initiative and is looking at a Solar Procurement Project and Electronic Plan Checking and Permitting Project.
  - CO2 San Mateo County has outlined an Energy Strategy with potential energy and water conservation programs that cities can adopt.
- Continuing climate protection outreach programs for the community, including on conserving energy and water.
  - Outreach includes articles in residential and business newsletters, messages on the local cable T.V. Station, MCTV, and on utility bills, and displays at City Hall and the Library.
- Expanding the City employee Commuter Options and Incentives Program to include additional employee programs and implement community wide programs.
  - Outreach will continue to encourage employees to take alternative methods of transportation. These options may include economic incentives to utilize different public transportation methods, acquisition of a shared City Hall electric vehicle, setting up a community-wide shuttle bus or van to carry people from the Millbrae BART station to popular points of interest in the city, encouraging carpooling, and conducting outreach on various related topics like walking during lunchtime to do errands and bundling errands via a personal automobile into one car trip.
  - Programs for the community will be evaluated and implemented.
- Soliciting businesses to participate in the Green Business Program. Finalize efforts to get the Library certified in January, 2009.